RADIO and ELECTRONICS

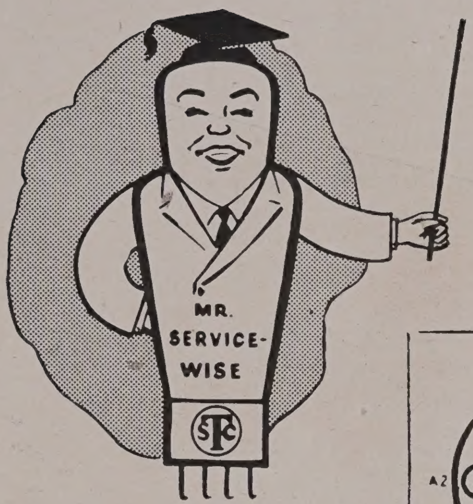
TELEVISION - COMMUNICATIONS - SERVICE - SOUND

NOVEMBER, 1st, 1953

VOL. 8, NO. 9

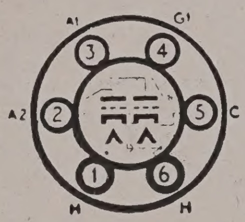
6B5s. are short - it's true

★ so BRIMARIZE with a 42

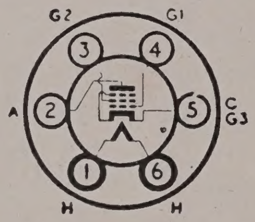


The 6B5 comprises two triode units in cascade, whilst type 42 is a pentode. Both valves have 6-pin bases so connected that replacement is possible without change of wiring.

Type 6B5 develops its bias internally and it will be necessary to include a bias resistor and condenser in the cathode lead of the 42 valve.



TYPE 6B5



TYPE 42

RATED CHARACTERISTICS

	6B5	42
Heater Voltage	6.3	6.3 volts
Heater Current	0.8	0.7 amp
Anode Voltage	300	285 volts
Anode Current	43	38 mA.
Bias Resistor	—	400 ohms
Optimum Load	7000	7000 ohms
Power Output	5.0	4.2 watts

TYPE	CHANGE SOCKET FROM	CHANGE SOCKET TO	CHANGE CONNECTIONS FROM OLD SOCKET	CHANGE CONNECTIONS TO NEW SOCKET	OTHER WORK NECESSARY	PERFORMANCE CHANGE
42	U.X. NO CHANGE	6-PIN	NO CHANGE		Insert Bias Resistor (400 ohms 1 watt) and by-pass condenser (25 μF., 25 Volts) in series with the cathode lead to pin 5 of socket	NEGLIGIBLE

★ *BRIMARIZING . . . A scheme devised by BRIMAR to keep repair lines on the move. This is especially useful at Christmas, when everyone wants his set at home and not on the shelf waiting for spares.*

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Radio and Electronics

VOL. 8, No. 9 1st November, 1953

OUR COVER:

After offically opening the Twentieth National Radio and Television Exhibition at Earl's Court, London, recently, Viscount Montgomery watches a member of the Royal Electrical and Mechanical Engineers, 3rd Training Battalion, assemble a radio set on the stand of the Regular Army.

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Contents

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A Government Policy Statement—Or Was It?

Such as it was, the Government policy statement concerning television has been received with little or no public comment. In this issue, we do not ourselves intend to offer opinions, but rather to leave it to some of the prominent men of our radio industry to say what they think. First of all, Mr. Ralph Slade, President of the Radio and Television Manufacturers' Federation, comments as follows:—

"In years to come, we shall look back over our old files of *Radio and Electronics* and be pleased to think that this Special Television Supplement was a milestone in the progress of our industry.

"Twenty-seven years ago we hardly existed, and, at that time, only one home in a hundred had a so-called radio set. Today, 95 per cent. of our homes have their radios—and very good radios they are, too.

"During that relatively short period, we have seen spring up out of nothing a virile young industry, basically highly technical, which is now looking for new avenues of expansion and new fields of technical activity and endeavour. Naturally, we look to television to supply the next challenge to our initiative and technical skill.

"Notwithstanding political caution, we know that a television service in New Zealand cannot be long deferred. Already we see the results of our preparations in the highly successful public demonstrations of excellent quality TV by one of the members of our industry. To my mind, the most significant feature of these demonstrations lies in the fact that the highly complicated transmitting and receiving equipment involved was designed and constructed in New Zealand in the extraordinarily short period of six or seven months. Such an achievement should not be overlooked in the welter of propaganda that TV brings with it. Above all things, it indicates the high level of technical skill and the initiative and versatility of the design engineers and technicians we have within our ranks.

"In the pages of the *Special TV. Supplement* of *Radio and Electronics,* you will see a great deal of confirmatory evidence of this statement; so much so, that no one need fear our industry's inability to supply the New Zealand viewer with locally designed and constructed TV sets of the highest quality that can be built.

"Thus, after only twenty-seven years, we suddenly find ourselves already engaged in meeting and mastering a new technique and adding it to that vital store of knowledge which prepares us for the 'next step.'

"Perhaps this expression sounds too visionary, but many of us can hazard guesses which are enough to make the head whirl. Suffice it to define the future by the term 'the electronic age ahead.'

"So limitless are the prospects, that we can never become a moribund industry, for which we should all be extremely thankful. What marvellous possibilities we offer to the technically minded youth of today! If it were possible to be granted one wish in this life, mine would be to be young again! As the number of my summers is no longer small, I can only advise parents and any studious young men with a strong urge towards electronic activities, to seriously consider the future scope of the present radio industry, which affords unexcelled opportunity for a most interesting and really worth-while carer.

"I believe this special Television issue of *Radio and Electronics* does indicate some part of our future activity, and I congratulate the Editor and the contributors alike for having made that possible.

Mr. P. C. Collier, Director of Collier & Beale, Ltd., says:

"It is a matter of regret to the Dominion as a whole that the main issues concerning the institution of a public TV service in this country—i.e., whether we are to have such a service and when, are still undecided.

"That there are technical and economic problems involved is undisputed, but, in my opinion, these problems become no less merely by constant reference to them. In fact, if we acknowledge the inevitability of new developments in the art, continual deferment could practically rule out much hope of ever getting started on a calm and rational basis.

"Sociological problems—if they really exist—will resolve themselves by the wisdom and will of the people and not necessarily only by the well-meaning but often misguided intentions of those who choose the role of arbiters of public opinion and expression.

"A degree of self-interest is already evident, and many of the specious arguments raised against TV are directly traceable to such opinions rather than based on fundamental facts.

"There are, in my opinion, only two real problems involved: the financing of the service and its maintenance, and the provision of programmes of acceptable form.

"The first of these is simply resolved if we accept the fact that the service is for the public benefit and thus is legitimately chargeable on a scale such as to ensure a reasonable recovery from direct users. From the entertainment angle alone, it should be possible to ensure a public subscription rate of adequate proportions without any relationship to the present quite inadequate listeners' licence fee.

"The programme issue is already showing some evidence of settling down in those countries that operate regular services at the present time, and it is interesting to observe that it is not necessarily the lavish and spectacular presentation which holds the viewers' interest.

"New Zealand could and should institute its own service now, giving everyone the opportunity of learning at first hand the issues involved, rather than the present process of 'wait and see,' with the ever-increasing mass of conjecture and confusing opinions. No one expects complete Dominion coverage overnight, and no one is yet competent to say just what may be involved in achieving such a state. Time and experience will provide the answer here as well as the solution of the general problems as they arise."

Mr. D. T. Clifton Lewis, Managing-Director of Radio (1936) Ltd., says:

"Now the Honourable Minister of Broadcasting has made a pronouncement that the TV Standards will be 405 lines based on the English system, this is of value to the technician only, but does not give the

(Continued on page 47.)

★ **THE IDEAL GENERAL PURPOSE UNIT**

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Available as a Complete Deck or in Kit Form (exclusive of tape). Will take 3M (Minnesota Mining and Mfg. Co.) tape or other standard tapes. Tape speed approximately $7\frac{1}{2}$ inches per second. Extra pulley wheel can be supplied to increase speed for high fidelity. Working instructions, wiring diagrams, and suggested amplifier circuit included in kit. Deck available mechanically assembled requiring only wiring to motors and main switch which are provided, also record/playback head.

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SPECIFICATIONS

TOP PLATE: $12\frac{3}{4}$ in x $10\frac{3}{4}$ in.; finished in Grey Crackle; overall depth, 5 in.

MOTORS: Two A.C. One direct drive on to capstan; other high-speed rewind.

CAPSTAN: Heavy solid brass. Engine turned in one piece, guaranteeing perfect accuracy; rotates on half-inch ball-bearing. Rubber drive fitted. Cemented and finally ground in position.

SPOOL SPINDLES: Of high-quality steel, revolving on solid gunmetal brackets on ball-bearing centres.

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Test Equipment for the Amateur—No. 1

An I.F. Alignment Oscillator

For those who build their own radio receivers, one of the most pressing problems is the ever-present one of alignment. Commercial signal generators are much too costly to consider, while no one wants to take his newly-built set to a serviceman to have it aligned if he can avoid it. In this, the first of a new series of articles, Radio and Electronics *describes a highly stable 455 kc/sec. oscillator and its power supply. These are built unit-wise, and form the first of a number of easily-built and inexpensive pieces of gear, designed to bring good test equipment within the reach of all.*

INTRODUCTION

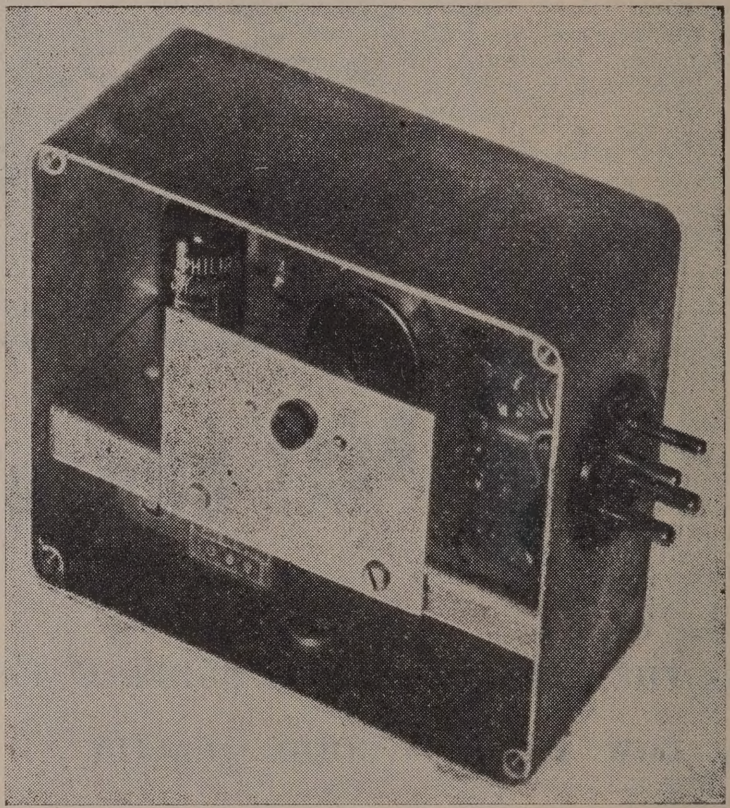
Building radio sets, as most readers of this journal will agree, is a very fine pastime. It is followed by people of all ages and occupations, and gives a great deal of pleasure not only to them, but to their families and friends. Even so, like most other hobbies, it has its drawbacks, one of which is that lack of test equipment frequently makes it difficult for the amateur constructor to align a set once it has been completed. Most of those concerned must manage to circumvent this trouble in some way, for otherwise most of those who start off with a burst of enthusiasm and creative energy would soon become "browned off" with radio, and take up model aeroplanes, or even gardening!

Let us have a look at the problem, and see if it is so insurmountable after all. If we can refrain from twiddling the tuning adjustments of the I.F. transformer until after the set is completed, we may be lucky enough to find that the "back end" is in approximate alignment, since most makers of I.F. transformers tune them to frequency in a test jig before packing and dispatching them. In this case, a little careful adjustment with a screw-driver enables the I.F. stage (or stages) to be peaked to some frequency which is probably quite close to 455 kc/sec. Unfortunately, it may not be possible to do this, for a number of reasons, and if the I.F. adjustments are far out, then nothing short of an oscillator running at the correct frequency will enable them to be brought back. Even supposing the I.F. stages are nearly enough correct, the builder still has no means of telling whether they are five, ten, or even fifteen kilocycles out. And what of the alignment of the rest of the set? If it is broadcast only, then some intelligent fiddling with the trimmers may put things approximately right, but even if after this, the sensitivity seems even over the band, and the dial pointer seems to be telling the truth, the real enthusiast will not be satisfied, and we, for one, don't blame him. Of what use is much careful construction, to an original or to someone else's tried design, if when all is finished, the builder cannot guarantee that the set is working at its best?

One way out of the difficulty, of course, is to take it to a professional serviceman to have it aligned, but this is by no means a satisfactory solution either. There is always the feeling that the professional gentleman may have skimped the job, and may therefore not have got that last ounce of performance out of one's own brain-child. Besides, it is most unsatisfying not to be able to finish the job off oneself.

SOLUTION TO A PROBLEM

As a periodical with many amateur readers, this journal has been racking its collective brains for some time, trying to find an answer to this difficult problem, but at last we think we have it. It may not be a perfect solution, but it is certainly AN answer, and we have great hopes that our readers will find it so.



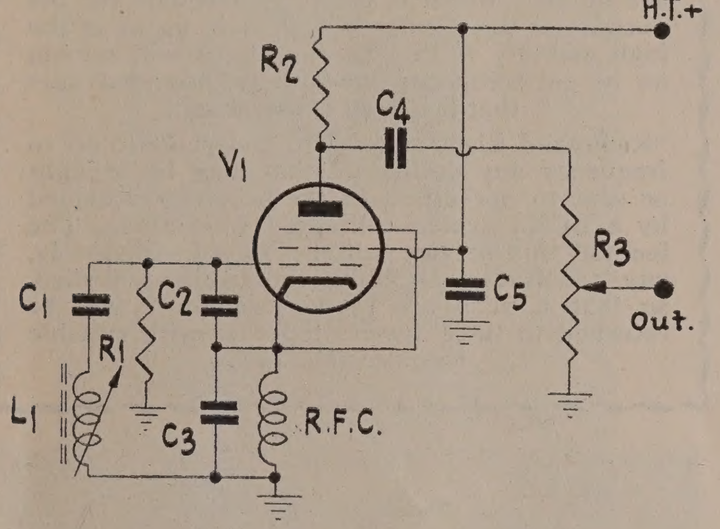
Back view of the oscillator in its cast-metal box, with the lid removed. The small plate, held to the chassis with two self-tapping screws, supports the oscillator coil, L_1. On the front of the box appear the coaxial output socket and the output control, R_3.

The difficulty, of course, is that commercial test equipment, as used by professional radio men, is far too expensive for those who pursue radio solely as a hobby. A good deal of it is also too expensive for many professional people! At the same time, alas, it is generally much too difficult or time-consuming to think of building it oneself, when it is considered what relatively little use it is likely to get.

At this point, we had better leave test equipment generally, and come specifically to the subject of this article, namely signal generators. The commercial variety usually cover a range of something like 100 kc/sec. to 30 mc/sec., or even higher. It is provided with a nicely

calibrated attenuator, to enable sensitivity and stage-gain measurements to be undertaken, and in order to make the attenuator effective at lower output levels, quite elaborate shielding has to be indulged in.

While this is all highly desirable, and even essential, for professional use, the amateur does not need these features at all; he can well put up with a signal generator which will produce a few spot frequencies accurately, and which possesses neither elaborate shielding, nor an expensive attenuator system. The gear to be described in this and subsequent articles comes within the scope of the amateur enthusiast both to build and to pay for, by virtue of its extreme simplicity, yet it will enable him to do all he wants. At the same time, it possesses features not shared by any of the commercial test equipment we have yet seen.



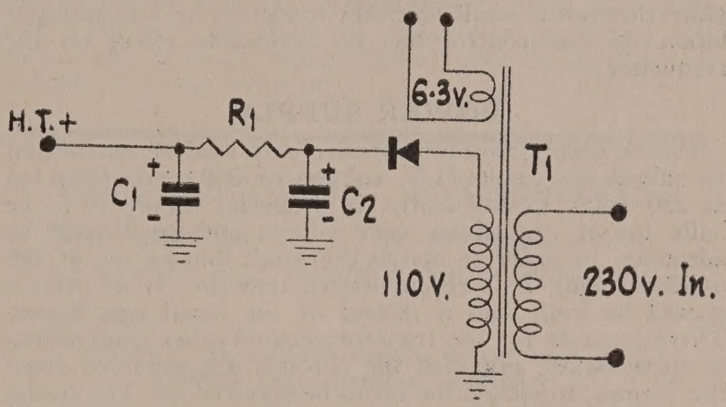
COMPONENT LIST

C_1, 125 $\mu\mu$f. mica.
C_2, C_3, 0.004 μf. mica.
C_4, C_5, 0.005 μf. mica.
R_1, 50k.
R_2, 1000 ohms.
R_3, 2000 ohm Pot.
L_1 and R.F.C., windings from 455 kc/sec. I.F. transformer (see text).
V_1, EF91 or 6AK5.

SCHEME OF THE EQUIPMENT

Needless to say, the complete home-built signal generator equipment will not be described in this article, which however, is complete in itself, and describes a power supply, suitable for the complete signal generating gear, and the fixed-frequency I.F. oscillator.

Indications have already been given of the form which the equipment will take. Initially, we have a highly stable 455 kc/sec. oscillator, for use in I.F. alignment. Some thought was given to the question of making this oscillator variable in frequency over a small range, but ultimately, the fixed frequency idea won the day. Having regard to the fact that it is intended primarily for those whose main interest is in building new equipment, there is little or no call for any other frequency than 455 kc/sec. since this frequency can now be regarded as a standard, only to be departed from for special purposes. By making the frequency fixed, several advantages arise, the main one of which is that the oscillator can be made to have almost as good frequency stability as a crystal oscillator. Thus, once the oscillator has been set on frequency, there will be no need ever to doubt its accuracy, even if the valve is changed and even if it is run from different supply voltages at different times. The other main advantage is that setting to frequency, or calibration becomes a very simple business, which can be carried out quickly and accurately (and therefore at small cost) by anyone who possesses a suitably accurate source of signals. Even a simple variable-frequency oscillator needs a considerable amount of work done on it to calibrate it, so that anyone who can be found to do it could reasonably expect a relatively large fee in return. Also, it is a much more difficult matter to keep a variable frequency oscillator accurately calibrated than a fixed one, since the same highly stable oscillator circuit cannot be used. Another advantage of the fixed oscillator is that its output voltage can easily be varied without any noticeable effect on its frequency. This last remark applies equally to attenuating the output with a potentiometer, and to varying the output at an audio rate, as when it is modulated. Tests on the



COMPONENT LIST

C_1, C_2, 16 μf. 250v. Electro.
R_1, 1000 ohms.
T_1, as marked, 30 ma. H.T., 1 amp. Heater.
Rectifier, RM1.

finished oscillator showed that a 50 per cent. change in H.T. voltage varied the output frequency by no more than 0.044 per cent., so that with normal voltage variations, such as can be expected in practice, the stability should be equal to that of a quite good crystal oscillator. It is worth noting that even the best standard signal generators never claim a setting accuracy of better than 1 per cent.!

THE CIRCUIT

The circuit is nothing more or less than the amateur transmitter's old friend the Clapp oscillator, with the values scaled up to make it suitable for a low oscillation frequency. Apart from its exceptional frequency stability, this circuit has the great advantage that it does not need a coil with any more than one winding, and on that, no tappings are required. It is thus very easily built for any desired frequency, provided only that a high-Q coil of the right inductance is available. For 455 kc/sec., this requirement is very easily met by filching one winding from an I.F. transformer. The latter should preferably be a modern iron-cored one, for in that case its Q will be over 100, and probably more like 120 or 130 if it is a good one. Another reason why it should be an iron-cored type is that the slug is then available as a pre-set frequency adjuster, thus enabling the main tuning condenser, C_1, to be a fixed one, as opposed to a trimmer. This, too, assists the stability materially. A portion of it can be given a negative temperature coefficient, which will take care, to a large extent, of the temperature rise that will certainly occur when the oscillator is totally enclosed in a small metal box.

The other winding of the I.F. transformer will not be wasted, as it can be used for the cathode choke labelled R.F.C. in the diagram.

The valve chosen was the EF91, which was picked from the available range of miniatures on account of its high mutual conductance. One characteristic of the Clapp oscillator circuit is that it positively requires a valve of this sort. For instance, if the circuit is built with no change of values, and an ordinary pentode like a 6J7 or EF36 used in it, the result would simply be no oscillation. However, those who have suitable valves of other types can use them successfully. A 6AK5 or 6AG5 would be found quite suitable. Indeed, the circuit was tested in our laboratory with a 6AK5, and was found to work well, but at reduced output voltage. This is to be expected on account of its lower Gm. Output is taken from the plate of the valve simply by inserting a low value of plate load resistance, and coupling from the plate through a small blocking condenser to R_2. Manipulation of this control has no noticeable effect on the frequency.

POWER SUPPLY

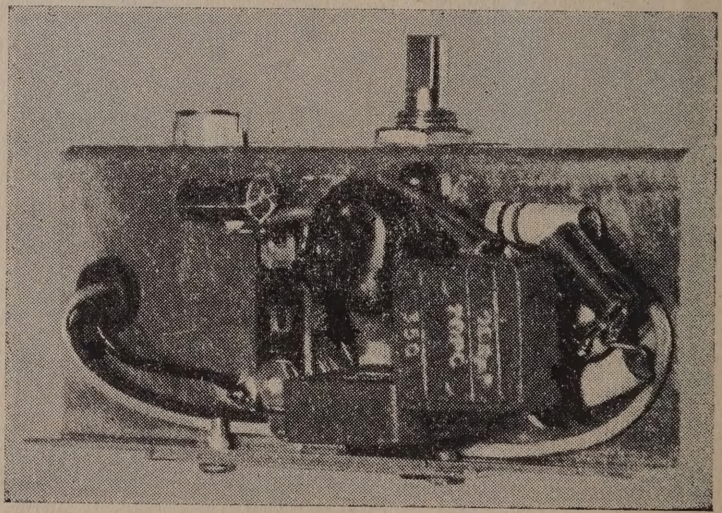
Power supply requirements are very modest, amounting to only 7 ma. at an H.T. voltage of 200, and about ten at 250 volts. Consequently, if a special supply is to be built for it, something very simple and small will be adequate. In order to match the small dimensions of the oscillator unit, it is recommended that the circuit shown should be built into a second of the small cast boxes. There is room for the transformer and other components in these boxes, provided the shrouds are removed from the former, to enable the lid to be screwed on. The transformer is rated at 30 ma., so that there is plenty in hand for future developments, such as a modulator unit (which can also be built into one of the cast boxes) and other equipment to be described in this series. Smoothing does not need to be extremely good, so that the simple R.C. smoothing circuit shown will be found quite satisfactory. A metal rectifier enables the single 6.3v. winding on the transformer to be used entirely for such filaments as may be needed in the gear itself, instead of using up a large part of its rated output in supplying the rectifier heater.

The output of the oscillator is rather larger than might have been expected, as it gives 4v. peak, or 2.8v. R.M.S., with 200v. H.T. supply and approximately three-quarters of this at 150v. This output voltage is more than enough, even in cases where an I.F. amplifier is well out of alignment and a large input to the last I.F. transformer is required in order to produce a signal on which to commence adjustment.

CALIBRATION

Those who are unable to calibrate their oscillators, once completed, will have to take them to someone with a signal generator to have them calibrated, or rather set to the correct frequency. Any commercial signal generator will enable the frequency to be set to within 1 per cent. of 455 kc/sec., which is perfectly adequate for the purpose of the oscillator. The main virtue of the high stability is that the oscillator will remain on its set frequency indefinitely, provided only that it is well constructed.

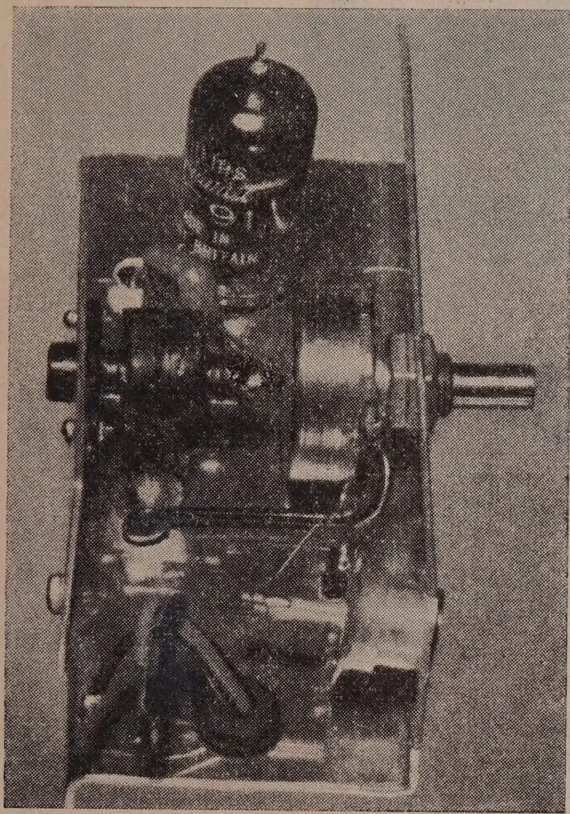
"Radio and Electronics" will undertake to set to frequency any oscillators that may be brought or sent to our office, to the accuracy provided by a BC221 crystal-calibrated wavemeter. The fee for this service will be 7s. 6d. Obviously, any constructional faults cannot be remedied, so that if such are found, oscillators will be returned to their owners together with suitable recommendations.



Under-chassis view of the oscillator. The large condensers are the 0.004 μf. micas, C_2 and C_3. The black object is the cathode R.F. Choke.

CONSTRUCTION

The photographs show the method of construction very well. The cast boxes are commercially available, and besides making a very neat job, save a great deal of work. The large hole for the power plug can be cut with a screw-type socket punch, but we would not recommend using the type of punch which needs hammering. Although the material of the boxes seems rather tough, and less brittle than most of the strange alloys used for such castings, it may not stand up to heavy hammer blows without disintegrating. An alternative, of course, is to bore a number of small holes round the required $1\frac{1}{8}$ in. circle, and to clean up the resulting hole with a rat-tailed file.



Top-chassis view, showing the valve, L_1, the output potentiometer, R_3, and the output socket.

The chassis is simply a flat sheet of aluminium with two bends in it. It is held to the box by means of the mounting nut of the potentiometer, and the small bolts holding the coaxial output socket. These go through the front of the box, the socket, and the chassis, in that order, after which the nuts are put on and the bolts tightened. The lid of the box plays no part in the construction, being merely a lid. When off, it exposes the adjustable iron core of the tuning coil. This can be set, and the lid replaced, without any sensible effect on the frequency setting.

The small piece of aluminium sheet, on which the tuning coil is mounted, is attached to the narrow flange of the chassis with two self-tapping screws.

COMPONENTS

In the prototype illustrated, both the tuning coil and the cathode choke were windings from an old ZC1 I.F. transformer. It may not be generally realized, but these transformers were of excellent quality, in spite of their somewhat poor appearance, which is due mainly to large lumps of impregnating wax. Most of this can be carefully run off by holding the windings near enough to a hot soldering iron to melt the wax. The individual coil formers have two small feet, by means of which they are attached to the bakelite frame inside the can. The frame is discarded, and the individual coils are screwed directly to the aluminium chassis. It will be noted that the tuned circuit components have been mounted above the chassis; i.e., on the same side as the valve and output potentiometer. All other components except the output socket are mounted underneath, and terminated on the valve socket lugs.

Since most I.F. transformers for 455 kc/sec. these days have fixed condensers of 100 $\mu\mu$f. connected across them to make up the tuning capacity, the circuit values shown will do even if ZC1 transformer coils are not used. If other kinds of coils are used, different mounting arrangements will have to be made by the individual builder, but as long as the mounting is firm, all will be well. Take care, too, that the leads from the tuning coil are not able to move, because should they do so, they will probably shift the frequency.

An Excellent Feedback Tone-Control Circuit

Some time ago, this journal published a circuit, which has been used several times since, with slight modifications, for a response-correcting amplifier for gramophone pick-ups. In October of last year, P. J. Baxandall, writing in the "Wireless World," described a basically similar arrangement, capable of producing both lift and cut for both treble and bass, independently of each other. This circuit has much to recommend it, and a simple modification is described here, which makes it suitable in cases where stepped control is considered more desirable.

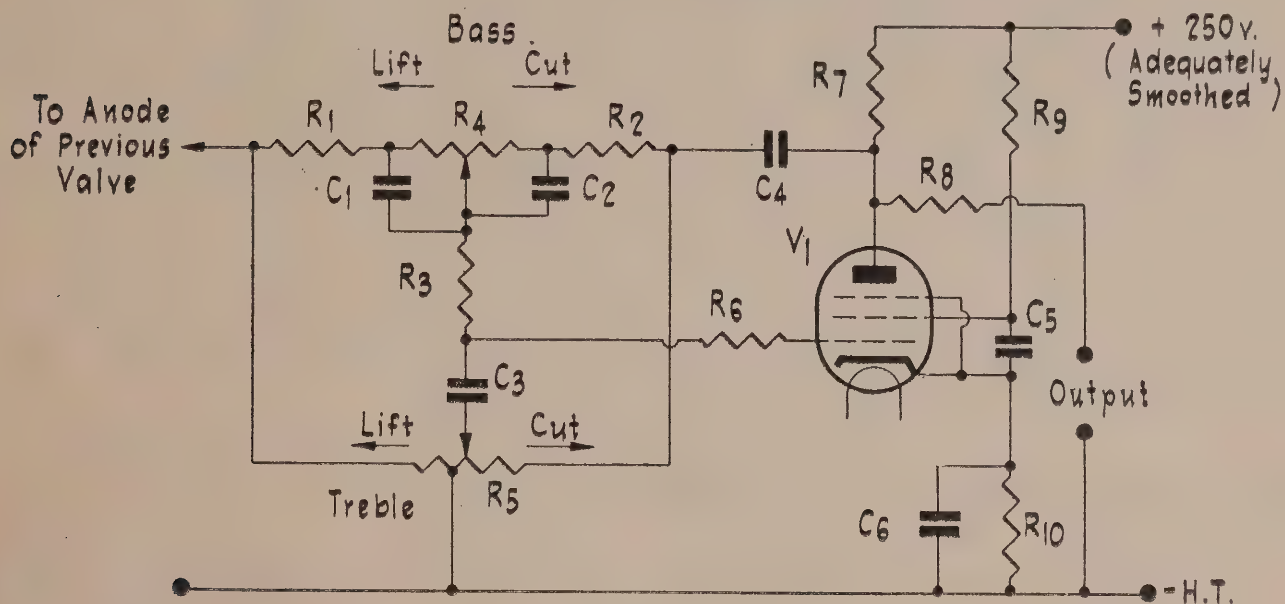


Fig. 1

R_1, R_2, 100k.
R_3, 470k.
R_4, 1 meg. Pot.
R_5, 500k. Pot.
R_6, 1000 ohms.
R_7, 68k.
R_8, 4.7k.
R_9, 220k.
R_{10}, 500 ohms.
C_1, C_2, 0.005 μf. mica.
C_3, 100 $\mu\mu$f.
C_4, C_5, 0.25 μf.
C_6, 50 μf. 25v. Electro.
V_1, EF50 or SP61.

INTRODUCTION

There have been many and various circuits proposed for providing variable control over both bass and treble response in amplifiers and receivers, but many of them suffer from one or more disadvantages which rule them out in many applications. Some are too complicated, others produce too much hum, others again give boost only, and still more add gain that is usually not wanted, and thus becomes an embarrassment. A common fault with such circuits is that they produce considerable distortion, and for high-fidelity purposes, this alone cannot be tolerated, let alone some of the others mentioned above. A well-tried method of frequency-response juggling, if we may call it that, is to employ an amplifier stage using negative feedback, the latter varying at different frequencies. Thus, if the feedback link from input to output of the stage concerned does not have a flat frequency response, neither will the stage itself. This comes about in the following way. First, let us suppose that the feedback network is such that at some particular frequency, less signal voltage is fed back to the input of the amplifier. Then, at that frequency, the amplifier will have more gain than at all other frequencies. Extending this principle slightly, it is not difficult to see that if we give the feedback network a falling response in some region of the audio range, then the amplifier will have a response which rises in that range. In like manner, if we want an amplifier response which falls over a certain range, we can do it by arranging for the feedback chain to have a rising response over the desired range.

Expressed in the simplest possible terms, all this amounts to the fact that in a feedback amplifier, the resulting amplifier response is the exact inverse of the frequency response of the feedback link between the input and output of the amplifier. This is true whether the amplifier has only one stage or many. In fact, the principle is a quite universal one. Of course, certain reservations must be made if practical results are to be exactly as predicted by this rule. The main one is that over the frequency range in which one is interested, the amplifier itself must have a level frequency response.

APPLICATION OF FEEDBACK RESPONSE-CONTROL

Up till now, several circuits have appeared in these pages which utilize the principle referred to in the last paragraph. The earliest of these to do so was the "10-Watt Economy Amplifier," featured in the March, 1949, issue. In this circuit, the amplifier was provided with overall feedback from the secondary of the output transformer to the cathode of the voltage amplifier pentode, which was the first stage. Condensers and resistors were used to give the feedback voltage a controllable amount of fall-off at low and high frequencies, each independently of the other. The result was controllable

amounts of bass and treble boost in the response of the amplifier itself.

The same principle has also been used, applied to a single amplifier stage in providing a response curve suitable for compensating for the fact that records are not made with flat frequency response characteristics.

In the circuit presented here, the same principle has been used. It is applied to only one stage, but has been elaborated to give not only bass and treble boost, but bass and treble cut as well. Only two controls are brought out to the front panel, since obviously, we cannot use bass boost and bass cut at the same time.

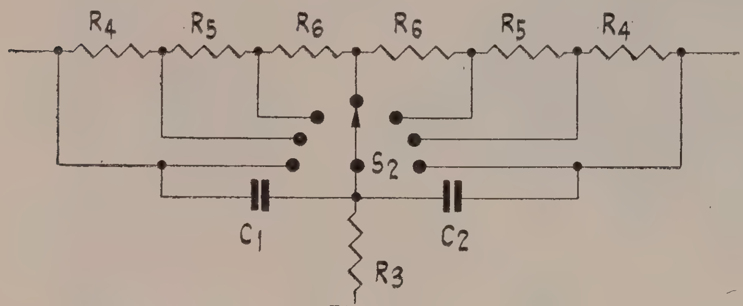


Fig. 2

R_4, 100k. R_5, 200k. R_6, 200k.
Substitution of seven-position switch for P_1 on the main diagram. The centre position gives a flat response.

One of the difficulties of Baxandall's original circuit, which is shown as Fig. 1, is that to give an almost linear effect to manipulation of the controls, linear potentiometers are required. In this country, these are not generally available. Another point worthy of consideration is whether a continuously variable control is desirable in any case. This question, we feel, is one that will be fairly hotly debated, and there are certain to be many readers to whom a stepped control will appeal more than a continuously variable one. Accordingly, Figs. 2 and 3 show the necessary modifications to Baxandall's circuit to give each control seven pre-set positions. As there are two controls—one for bass and one for treble, the use of seven-position switches means that each control will have one position giving a flat response, and three on either side of it giving boost and cut in three pre-set degrees. In each case, the string of resistors adds up to the total value of the potentiometer given in the original circuit, so that the performance does not differ from the original in the total amounts of boosts and cut that are available.

PERFORMANCE OF THE CIRCUIT

With the circuit values shown, and with the valve indicated, the boost and cut available can be described as follows: The bass boost and cut controls act quite symmetrically. That is to say, when the slider of the bass potentiometer is moved to the left, so as to bring it by so many ohms on that side of the centre, the amount of boost is exactly similar to the amount of cut obtained when the control is offset a similar degree to the right. The same thing happens with the treble control, so that it is quite practicable to mark the positions of the switches in such a way that the degree of boost or cut is indicated. For instance, with the bass control fully left (as shown in the diagram), the boost is 15 db. at 50 c/sec., and with it fully right, there is 15 db. cut at the same frequency. With the control 400 k. from the centre, the boost or cut at 50 c/sec. is 9 db., while at 200 k. from centre, it is 4 db. From this description, it is apparent why a linear control potentiometer needs to be used. If it is not, then it will be very difficult to tell where the control is set. It might be thought that this is not necessary, but the ear is such a poor measuring instrument, especially when it is listening to music, that, unless the setting for the flat response is accurately known, the operator has no sort of idea as to how much boost or cut he is using. The argument that it is the

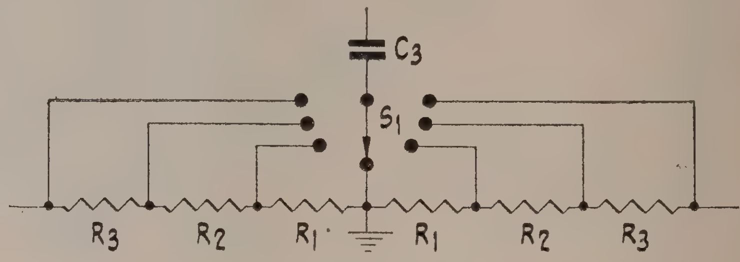


Fig. 3

R_1, 50k. R_2, 50k. R_3, 150k.
Substitution of a seven-position switch for P_2 on the main diagram. The centre position again gives a flat response.

sound of the results that is most important and that therefore a knowledge of the sort of response curve that is being used at any given time is not necessary, is completely disposed of by the undoubted fact that the users of controls of this kind are frequently at a loss to determine the best settings. The more one "fiddles," the less sure does one become of which settings give the best answer. Where only one control—bass or treble—is present, the situation is not quite so bad, but with both giving a wide variation in response, it is often possible to arrive at a combination of settings that is completely at variance with the requirements of the music.

This is rather well illustrated by an arrangement which the writer was asked to express an opinion upon quite recently. There were continuous bass and treble controls, similar to the one described here, and at the same time there were several positions of a compensation circuit intended to provide a level overall response from as many different recording characteristics. The result was that it was possible to obtain any sort of result, using any of the four positions of the compensation switch. It was even possible to get what sounded a reasonable result from L/P records with the compensation switch in the 78 positions! In other words, the provision of so much bass and treble control completely neutralized the effect of the compensation circuits, which might literally just as well have not been there! The writer was then asked to say which he thought was the better of two pick-ups! He had to point out that it was quite impossible to express an opinion unless the controls could be set so that, for a given type of record, the frequency response was known to be flat.

The situation is made difficult enough because of the rather wide variations between records, so that when it is confused still further by the addition of controls which give large amounts of boost and cut, it is quite impossible to tell whether a certain effect is due to the pick-up, the record, or to the setting of the controls!

At the upper end of the scale, 250 k. offset of the slider gives approximately 16 db. boost or cut, depending

on which way the control has been moved; 125 k. gives 11 db. at the same frequency, and 30 k. gives 2½ db.

SOME PRACTICAL POINTS

One important point that does not show up by examining the circuit diagram is that if the circuit is fed from a point of high impedance, the boost and cut will not have the values given in the last paragraph. In point of fact, the output impedance of the source of signal should not be greater than 10,000 ohms. This means that, ideally, the tone-control should be fed from a cathode follower or from a low-impedance triode, such as a 6J5 or 6C5, resistance-capacity coupled. The overall gain of the circuit at frequencies that are not affected by the tone controls is unity. This has the advantage that the arrangement can be inserted almost anywhere in an existing signal chain without introducing undesired amplification. Because of this lack of overall gain, the circuit will handle quite large signal voltages. Up to 4 volts input can be used with exceedingly low harmonic distortion, so that those possessing amplifiers of excellent quality need have no fear that the introduction of this tone-control circuit will spoil the nice low distortion figures of the main amplifier.

Another useful thing about the circuit is its low output impedance. It is quite unnecessary to follow it with a cathode follower, since quite large shunt capacities can be connected across the output without affecting the response. The maximum allowable capacity is about 500 $\mu\mu$f., so that with coaxial cable of, say, 25 $\mu\mu$f. capacity per foot length, this would enable a length of 20 feet to be used without appreciable top cutting.

Since a low-impedance source is desirable, it would be possible to feed the circuit from a low-level, low-impedance pick-up, but this might not be desirable on account of hum. It would be better to use a stage of pre-amplification, with a cathode follower feeding the tone-control circuit.

CHOICE OF VALVES

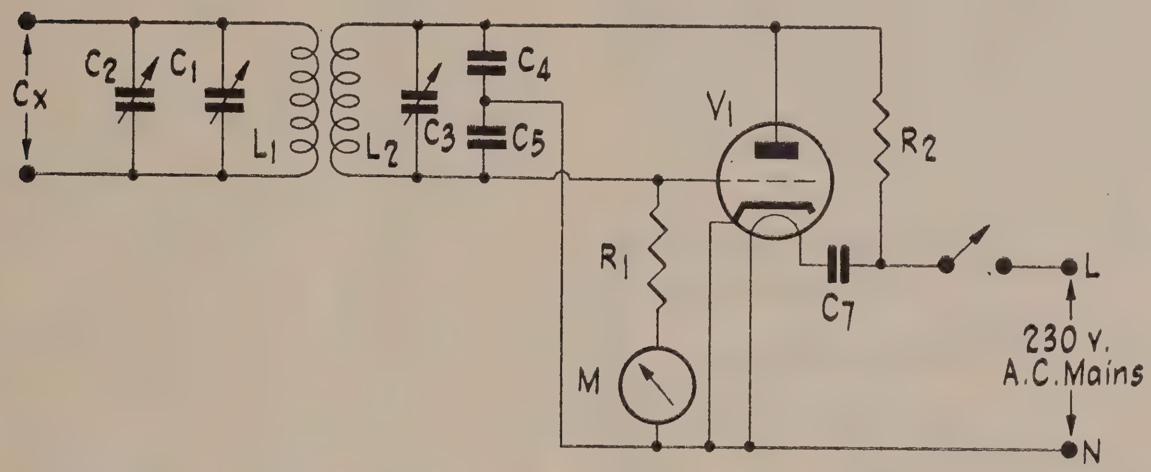
The valve used is not critical, and it is quite possible to employ triodes instead of pentodes. For instance, if a 6SN7 or ECC32 were used, one-half could be made into an input cathode follower, with the second half acting as the tone-control circuit. Normal resistance-coupled conditions should be used, whatever the valve used, unless it is a high-Gm. type, such as the EF91 illustrated. A conventional audio pentode can be used, such as a 6J7 or EF37, with its usual plate load resistor of, say, 100 k., and appropriate values, as obtained from the handbooks. If the signal input is much less than 1 volt, only the special low-hum pentodes such as the EF37 or EF40 should be used.

There has not been space here to go into the detailed mechanism of how this system works. Those interested are recommended to read Baxandall's original article in the October, 1952, issue of *Wireless World*, where a very full explanation of the somewhat complex method of operation will be found.

For the Amateur.

A New Use for the Grid-Dip Oscillator

So many uses have been found for the ubiquitous grid-dip oscillator that it is difficult to imagine any new ones. Even so, a British amateur transmitter has come up with one that seems to us to be "right out of the box." It enables the values of condensers from under 10 $\mu\mu$f. to 500 $\mu\mu$f. or even more, to be measured with sufficient accuracy for most purposes. Calibration can be done provided only that one or two close-tolerance fixed condensers are available.



V_1, any small triode—e.g., 6C4, 6C5, 6J5.
C_1, 500 $\mu\mu$f. variable, to be calibrated (see text).
C_2, 60 $\mu\mu$f. variable, to be calibrated (see text).
C_x, condenser, to be measured.
C_3, 50 $\mu\mu$f. variable.
C_4, C_5, 1000 $\mu\mu$f. mica.
C_6 (omitted), grid condenser, 500 $\mu\mu$f.
C_7, 0.25 μf.
R_1, 50k.
M, 0-500 μA meter.
L_1, L_2, windings from 175 kc. I.F. transformer.

INTRODUCTION

Those amateurs who build their own equipment frequently sigh for some means of measuring the capacity of small and medium-sized condensers, particularly when transmitters and receivers are under construction. Values of fixed condensers can then be checked to see if they are within their supposed tolerances, sections of split-stator or ganged condensers can be checked to determine how closely the sections agree with each other, and a hundred and one other small jobs done in order to eliminate a large proportion of the inevitable guess-work that has to go on when proper measuring gear is not available.

Bridges, which represent the most convenient means for measuring capacity, as well as resistance, are expensive to buy, and unless they can be accurately calibrated, are unprofitable to build up. This leaves the various methods of measuring capacity by using resonance. By and large, all these methods amount to is to place the unknown condenser across a tuned circuit, thus shifting its resonance frequency. Then, the original frequency is restored by taking out capacity from a calibrated variable condenser; the amount removed is then equal to the unknown, and can be read off the dial of the calibrated condenser.

This method is delightfully easy as long as the necessary equipment is available. It comprises an oscillator, a means of measuring its frequency, and, of course, the calibrated variable condenser. Now for extremely accurate work, these items can be very costly and accurate in themselves, and the substitution method becomes, if anything, more expensive than a bridge. But with the aid of simplified equipment, it is still possible to take measurement to a reasonable degree of accuracy, and yet finish up with very useful equipment costing a very few pounds. Once more, it is our old friend the grid-dip oscillator that comes to the rescue. The complete circuit is shown in the diagram. It consists of a simple Colpitts oscillator, in which C_4 and C_5 in series amount to approximately 500 $\mu\mu$f. Each is thus 0.001 μf. For adjustment purposes a variable condenser, which is pre-set, of 100 $\mu\mu$f. capacity, is connected across the pair. The inductance of the coil, and therefore the frequency at which the whole oscillates, is not important, but it will not be very high—probably in the region of 75 to 100 kc/sec. L_1 is a second coil, identical with the oscillator coil L_2, and it is suggested that the pair of coils could be the windings of a 175 kc/sec. I.F. transformer. In series with the grid leak of the oscillator we have a meter, 0–500 μamps., which is the grid dip indicator. L_1 and L_2 are spaced so that when the L_1 circuit is tuned through resonance at the oscillator frequency, only a very slight dip in the grid meter is observable. This means that the L_1 circuit is as loosely coupled as will enable an indication to be obtained, and this is done so that the L_1 circuit will have as little effect on the oscillation frequency as possible.

The variable condenser C_1 has a maximum value of 500 $\mu\mu$f., making the total capacity across L_1 approximately the same as that across L_2, so that with C_1 fully meshed, it is possible to trim C_3 so that the two are

resonant at the same frequency, as indicated by the meter. C_2 is a small variable, of about 60 $\mu\mu$f. maximum capacity, and its use will be described later. C_1 and C_2 are both calibrated, in as small steps as may be convenient, but because we have C_2 present, C_1 need not have calibration marks any closer together than 500 $\mu\mu$f. C_2 is then calibrated in smaller units—say, 5 $\mu\mu$f. intervals—so that the total capacity of C_1 and C_2 can be read to within 5 $\mu\mu$f. How the calibration is done will be described later.

USING THE DEVICE

In practice, C_1 and C_2 are first set so that their circuit is exactly in resonance with the oscillator, as shown by minimum reading on the grid meter. Then, the condenser to be measured is connected in parallel with C_1 and C_2, in the position marked C_x on the diagram. This tunes the circuit to a lower frequency, and resonance is then restored by taking out some of the capacity from C_1 and C_2. Then, from their dials is read the amount of capacity removed, and this is equal to the amount added, which is the unknown capacity.

From the above description, it can be seen that the grid dip oscillator fulfils the functions both of the oscillator and the frequency measuring device, so that apart from this, only the measuring condenser has to be provided.

CALIBRATION OF CONDENSERS

The calibration of the measuring condensers has necessarily to be carried out with some accuracy if the device is to measure capacities at all accurately, but fortunately, there is a very simple way of doing this, which does not depend on possessing any equipment other than one or two condensers whose values are accurately known. Basically, the idea is to calibrate the large condenser at 50 $\mu\mu$f. intervals only, since C_2 covers a range of 50 $\mu\mu$f. C_2 itself is then calibrated at smaller intervals—say every 5 or 10 $\mu\mu$f., and smaller intervals are estimated by eye. The equipment needed is as follows:—

(1) A close-tolerance 50 $\mu\mu$f. condenser—preferably $\pm$ 1 per cent.

(2) A close-tolerance 5 or 10 $\mu\mu$. condenser of the same accuracy as the 50 $\mu\mu$f. one.

(3) A 500 $\mu\mu$f. variable condenser which need not be calibrated, nor need its exact value at any setting be known.

Having provided ourselves with these materials, we proceed as follows:—

(1) C_1 and C_2 are both set at maximum capacity.

(2) C_3 is adjusted so that minimum grid current is indicated on the meter. If a large dip is obtained, the spacing of L_1 and L_2 is changed so as to reduce the dip to an amount that is as small as possible, consistent with being easily seen.

(3) The 50 $\mu\mu$f. condenser is connected across the test terminals, thus de-tuning the L_1 circuit.

(4) C_1 is reduced and set accurately at the point of minimum grid current.

(5) The setting of the dial of C_1 is marked "50 $\mu\mu$f."

(6) The variable condenser is connected across the

test terminals, and the 50 $\mu\mu$f. condenser removed.

(7) The variable condenser is adjusted to bring the circuit back to resonance. This procedure merely substitutes 50 $\mu\mu$f. of the variable condenser for the 50 $\mu\mu$f. fixed condenser. *Note.*—After step (5), C_1 is *not moved* while steps (6) and (7) are performed.

(8) The 50 $\mu\mu$f. condenser is again connected to the test terminals.

(9) C_1 is again shifted until resonance is restored, and the new point is marked "100 $\mu\mu$f."

(10) The 50 $\mu\mu$f. condenser is again removed, and resonance brought back by increasing the value of the uncalibrated variable.

(11) The 50 $\mu\mu$f. condenser is again attached, and C_1 adjusted.

It will be seen that the uncalibrated variable is used to add capacity in steps of 50 $\mu\mu$f. each time C_1 is marked with a new value, and that the fixed condenser is used to measure both the amount of capacity removed from C_1, and the amount added by the uncalibrated variable. Since each measurement is made at the same frequency, the total capacity in circuit is always the same. The use of the variable condenser enables only one accurately known fixed condenser to be used. Otherwise, it would be necessary to have a series of them so that jumps of 50, 100, 150 $\mu\mu$f., etc., could be added progressively.

When we come to the last step available on C_2, we will have calibrated it in 50 $\mu\mu$f. steps all over its dial, but the calibration will go backwards. This is in order, because as explained above, the thing is used by seeing how much capacity has to be *removed* from the circuit. The 50 $\mu\mu$f. variable, C_2, is calibrated with its 10 or 5 $\mu\mu$f. marks in exactly the same way, but this time a 10 or 5 $\mu\mu$f. condenser is used. If closer calibration marks are wanted, putting them on is merely a matter of getting hold of a small condenser of the appropriate capacity with which to repeat the performance.

POWER SUPPLY

We do not very much like advocating a circuit powered in the way shown in the diagram, as it can be dangerous if one is not careful. If this system is used, raw A.C. is applied to the valve, which conducts only on the positive half-cycles, and is called a self-rectifying oscillator. Actually, this circuit could be made quite safe by ensuring that the circuit is not earthed to the metal case at any point. Since the L_1 circuit is quite well isolated from the rest in the D.C. sense, there would be no harm in earthing one side of C_1 and L_1 to the case of the instrument. Of course, care would have to be taken with the preliminary adjustment of C_3, but as this is a pre-set control, which need not be touched more than

(Continued on page 48.)

Disc Recording and Reproduction

By V. M. STAGPOOLE

Since the end of World War II, interest in high-fidelity reproduction of records has risen to unprecedented heights. Record companies have, not unnaturally, attempted to cash in on this interest. After all, every record sold means a larger dividend at the end of the financial year, and advertising managers were quick to dream up pseudo-technical terms purporting to show that their products were more "hi-fi" than those of their rivals.

Engineering staffs were no doubt called upon to produce frequency records to back up these claims, and, unless I miss my guess, did so with considerable misgivings. It is not very difficult to trick up a disc recorder to produce 20 kilocycles per second, and not hard to record it towards the outside edge of the disc, but to call this a proof that this company can produce records of greater range than its rivals is a trifle optimistic.

It is considerably more difficult to record ten kilocycles towards the centre of a disc than 20 kc/s. at the periphery. If we are able to assume that the disc recorder can do all that is asked of it, it has to be remembered that it is only the last link in the chain, and the failure of studio, microphone, amplifiers, and tape-recorder to meet highest specifications will negate all the hardest efforts. Calls for expensive modern microphones and acoustically treated studios by recordists will be viewed with a rather jaundiced eye by the board of directors, who probably cannot tell the difference between Bach and boogie, and are tone deaf anyway.

Most audio enthusiasts go through three stages of development. First, they want it as loud as possible; secondly, they begin to demand good tops; and finally, they want to hear good bass. The first conditions are usually satisfied by the best of modern recordings. Good clean tops and loud passages without tearing noises have become the order of the day, but the last condition is by no means always fulfilled.

Just why this is so is hard to understand. It seems unlikely that the recording channel is incapable of recording these low frequencies, so one is led to the conclusion that a thin quality is deliberately cultivated.

A recent visitor to Europe tells that many recording studios still use 10-inch speakers in inadequate baffles for monitoring, so it is not impossible that those responsible for "balance," having got used to reproduction lacking in bass, tend to arrange the orchestra so that it sounds that way. Musicians being only human, the bass player is probably quite happy to earn his fee by playing softly rather than loudly.

This difference in the recorded bass is quite noticeable between various makes of records. Pre-war American records used to be infamous for lack of bass, although this fault has largely been overcome nowadays. Certain modern English records do have good bass, but, taking the large mass of recorded material as a whole, scarcely one record in ten is entirely satisfactory in this respect.

LONG-PLAYING RECORDS

Now that a large number of L.P.s are available, it is time to look critically at the technical quality of these discs. I am sorry to say that, in general, L.P.s have not come up to the high standard of the best 78's. Apart from odd ticks and pops inevitable from mass-production of fine-groove records, many of the discs suffer from defects which appear to be a concomitant of dubbing from tape. A lack of "top" is often noticeable, tape noise is apparent, and flutter rears its head.

It is now a standard feature of record production to take the original on tape. A 78 copy may be cut at the same time, but it is from the former that the L.P. is dubbed. This does not mean, however, that all works are recorded straight through. The possibility of playing a complete symphony, or even one movement, right through without an error is small, so works are still divided into four or five minute sections. Thus, when the item is finally inscribed on wax, it may well be a dubbing of a dubbing. If, on the other hand, the original tape is cut and rejoined at suitable intervals, then the master recording is still a dubbing. Even assuming this latter case, we have

still added all the defects of tape to our disc. A modern disc-recorder is capable of less than one-half of 1 per cent. distortion, and a noise figure of better than 50 db. On the other hand, even the best tape recorder is hard put to it to produce less than 1½ per cent. distortion, and a signal-to-noise ratio of 45 db. In addition to these difficulties, the limited frequency range will restrict transient response, and flutter will be added to that already apparent, even in the best of disc recorders.

All this adds up to a peculiar sound which afflicts many L.P.s—a sort of strangled effect, with limited dynamic range, which can be most annoying to the technically trained ear. Strangely enough, many "pop" L.P.s suffer least from these faults.

No doubt, many of these faults will be ironed out in time, but it is annoying to spend large sums of money on technically poor music, no matter how good the performance.

A further difficulty that arises is the large number of recording characteristics that are available. Nearly all American recordings use a large amount of high-frequency pre-emphasis. The story usually given is that it helps to improve the signal-to-noise ratio. This may be so, but it happens to be a mere side effect of an entirely different process.

In 1932, when R.C.A. Victor changed from the old-style condenser microphone, which had a rising high-frequency response, to the ribbon velocity type of microphone, they found it necessary to boost the high frequencies in order to make the new records sound like the old ones. As the high-frequency range has been increased, the curve has been maintained without any levelling off. A boost of something like 15 db. at 10,000 cycles is now usual on American records, both 78 and L.P.

E.M.I.L.P.s have a similar characteristic, but Decca L.P.s use only some 10 db. of boost at 10 kc.

STUDIO TECHNIQUE

Most recording companies are rather secretive about the actual types and placing of microphones in their recording studios, but it is fairly obvious by listening that techniques vary from manufacturer to manufacturer, and often from disc to disc. Some fairly definite trends are apparent, however.

Decca (England) seem to favour the use of about three condenser microphones suitably placed to obtain that clean, crisp instrumentation for which they are justly famous.

E.M.I. appear to use two microphones, one on either side of the conductor and somewhat back of him. In America, the emphasis appears to be on the use of one microphone, usually placed well back and high up, although information is scarce on methods employed by the larger studios.

The best recording the writer has heard (an L.P., incidentally) was made by the use of a single condenser microphone placed some 15 feet above the conductor's stand. This is the celebrated recording of "Pictures at an Exhibition," by Moussorgsky, made in America by Mercury Records, but released locally under the H.M.V. label. This was played by the Chicago Orchestra conducted by Raphael Kubelik. It is, incidentally, a truly international effort. Russian music, arranged by a Frenchman, conducted by a Czechoslovakian, played by an American orchestra into a German microphone, and recorded with English cutterheads.

REPLAY CHARACTERISTICS

From the point of view of the record enthusiast, the above discussion is largely academic. We have to accept the records as we get them, but we can ensure as far as possible that they replay close to what we imagine the original sounded like.

In other words, we must ensure that our replay characteristic is that recommended by the maker. This is just where the difficulty arises. Not only must we compensate for the well-known characteristics of Decca and E.M.I. 78's and L.P.s, but also for all the odd American characteristics which appear under the latter's labels as well as their own. It should be remembered that in many cases the discs are pressed from the original American stampers and need equalizing accordingly. I can think of at least eight different characteristics available locally, so that the conventional boost below 300 cycles/sec. will not get us very far.

Two courses suggest themselves as possible solutions. Firstly, a switchable equalizer which supplies exact equalizations for each available characteristic, or, secondly, a fixed bass boost with adjustable treble and bass controls. Neither of these two possibilities is entirely satisfactory however, as the former is too complicated to build, and the latter too complicated to operate.

A combination of these two basic methods seems to offer the best possibilities, and is the method most used in practice. It is usual to have four or five fixed

equalizing positions, followed by variable base and treble controls which will allow the fabrication of a large number of characteristics. In more advanced designs, it is usual to have switchable bass and treble controls which enables the controls to be set at zero without any difficulty. Continuously variable controls cannot be accurately set and over a period of time may be so badly maladjusted that the reproduced sound bears no resemblance to the original.

DESIGN OF AN EQUALIZER AND TONE COMPENSATOR

The unit consists of two basic stages, the equalizer proper and the tone control stage. It may be preceded by a pre-amplifier stage and followed by an output stage if necessary.

(a) **Equalizer Stage.** Two methods are commonly used to produce the bass boost (and treble cut) required to obtain flat response from discs. A conventional resistance capacity loss circuit can be inserted between the plate of one stage and the grid of the next, or selective negative feedback can be installed over one or two stages. Having tried many circuits in the last five years, the writer is inclined to favour feedback over a single pentode stage for the simple reason that it sounds better. In addition, it is easy to construct and suffers from no "bugs." By switching various combinations of resistance and capacity between grid and plate it is possible to obtain any desired combination of bass boost and treble cut. This type of circuit was used by Williamson as a pre-amplifier in his quality amplifier and gave very good results. In practice it will be found necessary to apply more feedback than Williamson used, in order to get the 20 db.s of boost at 50 cycles required for older American records.

(b) **Tone Compensation Stage.** Of the number of circuits available, a circuit due to P. J. Baxendall described in October, 1952, "Wireless World" offers the best possibilities. Although used originally with continuously variable controls, it lends itself to our purpose if we substitute seven position switches with fixed resistors between the contacts.

The circuit consists of a pentode with heavy feedback between plate and grid, having an overall gain of about one, and capable of an output of up to four volts with a distortion of less than 0.1 per cent. at 5 kc/sec. at any setting of the controls.

These two circuits can be combined to give excellent results and it is proposed at a later stage to give constructional details of an equalizer and tone compensation unit suitable for a low level moving-iron pick-up, and radio tuner using these circuits.

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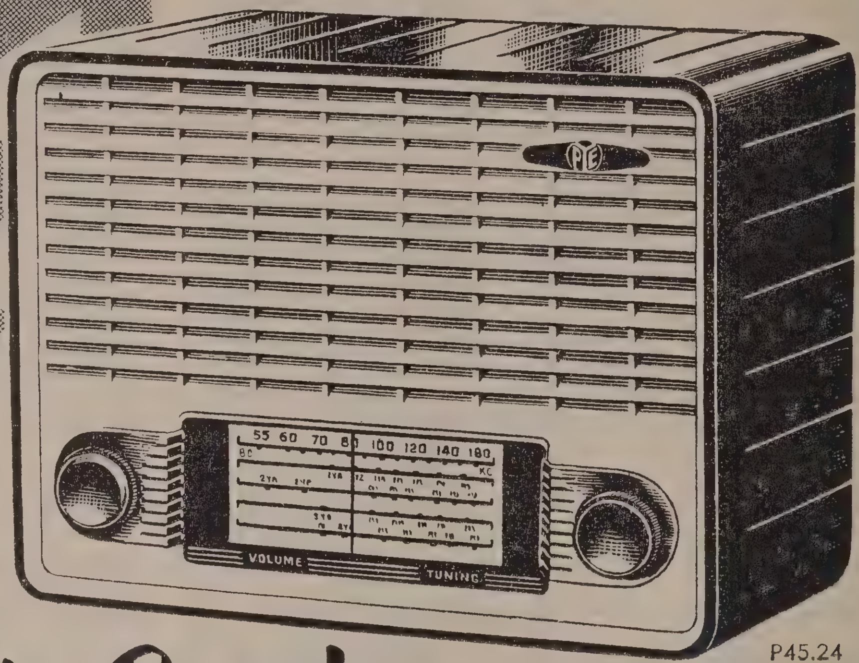

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Annual Report of N.Z. Radio and Television Manufacturers' Federation

In presenting his report to the Annual Conference of the New Zealand Radio and Television Manufacturers' Federation held at Waitomo on 24th September, Mr. R. Slade, President, reviewed many important aspects of the year's activities.

Television

It is considered likely that the release of the report of the Australian Royal Commission on Television might prompt the New Zealand Government to make a policy statement concerning a television service in New Zealand.

As yet, however, despite repeated promises by the authorities concerned, and the importance of the industry being given the opportunity to study the report and make constructive comment thereon as a prelude to the final adoption of a New Zealand TV standard, the technical details of the New Zealand Television Advisory Committee's recommendations have not been released to the industry.

Meanwhile, within the industry itself and in educational circles, there has been intense technical activity. Realizing the new techniques must be studied and mastered well in advance of the institution of a TV service, many units of the industry are engaged on TV constructional work. One Wellington firm has designed and built a complete television transmitter, camera, and several receivers, the picture quality of which is in no way inferior to that of the B.B.C. transmissions. Apart from the courage, resource, and high degree of technical skill thus demonstrated, this also convincingly proves that the New Zealand industry is entirely capable of manufacturing all the television receivers this country will need, and should correct the many inaccurate statements of ill-informed overseas visitors concerning the necessity for New Zealand to import TV receiving sets.

In Auckland, the Seddon Memorial Technical College has a TV and electronics course in its second year—a sound training scheme which could well be copied by other technical colleges. For over two years Canterbury College has had a TV transmitter and a number of receivers in operation in Christchurch, all the equipment being designed and built at the university for the training of electronic engineers. Similarly, the Wellington Branch of the New Zealand Electronics Institute is building TV transmitting and receiving equipment with the object of training its members in the new techniques, and the Editor of *Radio and Electronics* has been conducting well-attended technical TV courses in Palmerston North and Wellington.

Condenser Importations

After much delay, a meeting with the Board of Trade was eventually achieved without, however, a satisfactory result. The original 50/50 arrangement previously operating between local condenser manufacturer and the industry ended this year by the Board of Trade, without previously consulting with the industry, arbitrarily cutting the latter's quota by two-thirds. This means it can import only one-sixth of its requirements. Thus, an industry of increasing national importance and with tremendous future potentialities, is virtually debarred from taking early advantage of overseas advancements in condenser design. Moreover, it is forced to accept nearly all its requirements at high prices from a local monopoly whose fluctuating quality harms the industry in the eyes of important potential customers, most of whom demand the highest quality components in the equipment imported from overseas to the detriment of the local industry

It seems that the only redress is for the industry to ask for a Tariff hearing, so that the local condenser manufacturer can obtain tariff protection only. This, at least, would enable the industry, where necessary, to import condensers of the highest quality.

Defence Production and Developmental Contracts

The industry can be justly proud of the local design and quality, and the rapidity with which it has kept so closely up to date with results of overseas research. However, as many firms have found that their productive capacity considerably exceeds the total New Zealand demand, they have engaged in other pursuits, mainly electrical, which have not been altogether advantageous to the industry's proper electronic function. This error has been realized, and now most major units are adding industrial electronics and telecommunications applications to production schedules. The advent of TV in New Zealand will still further augment the electronic scope of the industry.

Thus, the trends of the industry are now crystallizing as the importance of a more scientific approach to problems is realized. The engagement of more scientific personnel, however, costs money which, with present high taxation and narrow profit margins is not easily covered out of existing production. The Federation Executive, therefore, has endeavoured to impress on the Government the ability of the industry to undertake certain electronic construction, especially for defence, and, furthermore, that a strong electronic industry is essential for every country today.

It has been encouraging to receive the suggestion of the Director of Civil Aviation, concerning the formation of a special developmental group-company which could be entrusted with certain developmental contracts, thereby meeting the requirements of both the industry and the Government. Though this plan is still under consideration, its practical aspects are not clear. For example, it is possible that, though the group may be allocated a development contract, there would not necessarily be any assurance that subsequent production would be undertaken by a New Zealand firm. Such a provision is essential if New Zealand is to develop production technique as well as design capacity. If the production contract were thrown open to other countries, our present exchange disparity and sales tax anomalies could and possibly would operate to the disadvantage of the industry.

Modern defence considerations automatically involve a powerful electronic industry, as witness the tremendous expansion in this field in the U.S.A., United Kingdom, Canada, and Australia. Most of this highly essential expansion has arisen from developmental contracts, the subsequent production of which has been deliberately retained in the country of origin.

In this respect New Zealand has seriously lagged behind, the hands of industry being tied through lack of appreciation in the right quarters of its present equipment, and capabilities, to say nothing of the antiquated system of contract allocation on price alone, without regard to long-term national welfare.

It is stimulating, however, to note the recent suggestion from the Director of Civil Aviation for the establishment of a Standing Committee on Radio, comprising representatives of the Federation and the Civil Aviation Administration, to consider and advise on matters concerning aeronautical radio and electronics equipment. It is to be hoped that encouraging signs in other directions will bear fruit during the coming year.

Interference

The problem is still grave in spite of P. & T. endeavours to keep it under control. Retailers are experiencing increasing difficulty in effectively demonstrating radio sets to prospective purchasers, and their trials will be increased with the advent of TV which is even more intolerant of such interference.

Synchronized ZB stations operating throughout the day from a more central position might be one solution. It is also desirable that the P. & T. Department should continue its excellent educational programme on interference limitation and reduction. Even more essential, however, is the conferment of legal powers on the P. & T. Department to enforce effective reduction on all offenders. Legislation compelling the compulsory fitting of effective interference suppressors to all new motor-cars, lorries and buses during production is also strongly advocated.

Sales Tax

The present sales tax anomalies are intolerable, and the existing high tax of 20 per cent. has a very adverse effect on the sale of radio receivers, thereby restricting the output of the industry far below its potential. On the introduction of TV, the situation will be infinitely worse.

If TV is to follow the same trend in New Zealand as in other countries, the potential demand will be heavy, if the New Zealand service provides main centre coverage. The initial investment by the industry will be heavy, and adequate quantities of receivers must be produced if the price to purchasers is not to be prohibitively high. In view of the future national importance of a strong New Zealand electronics industry and the necessity for its more rapid development, there is a strong case for no application of sales tax whatsoever during the first few years of TV set production. By the same token, the industry would gain strength if the present sales tax on radio sets was removed.

Confidential File of Statistics

Perhaps due to lack of faith in and appreciation of its value, on the part of members, this scheme has not been entirely successful as yet. Under this plan, units were requested to furnish group secretaries with certain production statistics, which it was considered would be of considerable value to members themselves, and to the Federation, in many important negotiations. Such schemes are common practice with overseas Federations where their value has been proved.

Guarantees

It is felt that the excessively long guarantees given purely as a means of securing sales is bad commercial practice, and the endeavours of the New Zealand Radio Traders' Federation to curtail this practice have been noted with appreciation. It would be particularly helpful if both groups could agree upon and maintain a standard period of guarantee.

(Concluded on page 48.)

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 73: Some New Philips Valves for Television and Other Uses

Reprints of these EXPERIMENTER articles, complete with illustrations, will be mailed to any address for one year for a subscription of 5s. Application should be made to Technical Publications Department, Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

Recent arrivals on the valve list are the members of a new Philips range which has been called the world series for television. These valves include a number of types which are specifically designed for television applications, but others of the series are eminently suitable for many uses other than television. For example, there are the Philips EF80 and EF85, which are high-mutual-conductance pentodes, the first of which is a sharp cut-off type, while the latter has a remote cut-off. Then there is the ECL80, which is a dual valve, containing a small triode and a small power pentode in the same envelope. This valve finds a multitude of applications in television circuits, but is also exceedingly useful for AM and FM receivers, and even in audio amplifiers. Another valve which should prove exceptionally useful in V.H.F. receiving and transmitting circuits is the ECC81, a double triode with separate cathodes, which can be used for anything from a low-powered V.H.F. oscillator to a push-pull R.F. amplifier for receivers, and even for an oscillator-mixer. Needless to say, all these valves except the ECL80 and others which are designed as line time-base output valves and video amplifiers will find more use in V.H.F. receivers and transmitters than at low frequencies, but they are also excellent for all cases where triodes and pentodes with high mutual conductance and low inter-electrode capacities are needed. In pulse circuitry, and for oscilloscope work, for example, these modern tubes will be found exceptionally useful. The purpose of this Experimenter is to describe some of the new valves in some detail, and to give a brief listing of the whole series, together with some suggested applications.

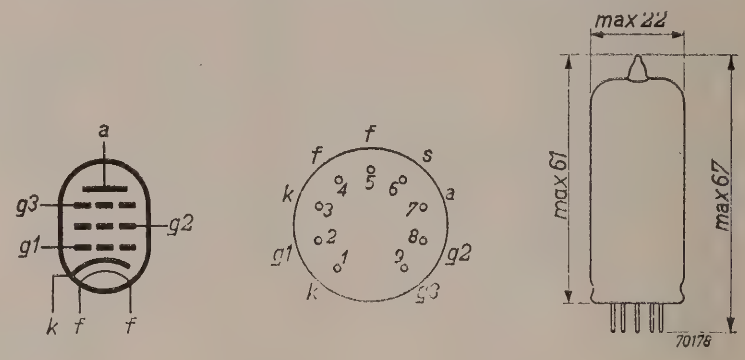
AMERICAN EQUIVALENTS

In these days, when it is almost impossible to obtain the more recently developed American valves, it is valuable to know that many of the Philips World Series are direct equivalents of some American types. These electrical equivalents are as follows:—

ECC81	equivalent to 12AT7
EF80	equivalent to 6BX6
ECL80	equivalent to 6AB8
PL81	equivalent to 21A6
PL83	equivalent to 15A6
EY51	equivalent to 6X2
EF85	equivalent to 6BY7
EB91	equivalent to 6AL5

THE EF80

This valve, whose arrangement of electrodes and socket connections is shown in Fig. 1, was designed primarily as a wide-band R.F. and I.F. amplifier in television receivers. It is suitable also for use as a V.H.F. frequency changer and as a video amplifier. Together with other tubes of the range, it has been designed to work satisfactorily with H.T. voltages as low as 170. It is effective as an R.F. amplifier or frequency changer at frequencies up to 300 mc/sec. Its mutual conductance at plate and screen voltages of 170 is 7.4 ma/v., and the input and output capacities are such that it has a gain × bandwidth product of 110. This means that if the valve capacities alone



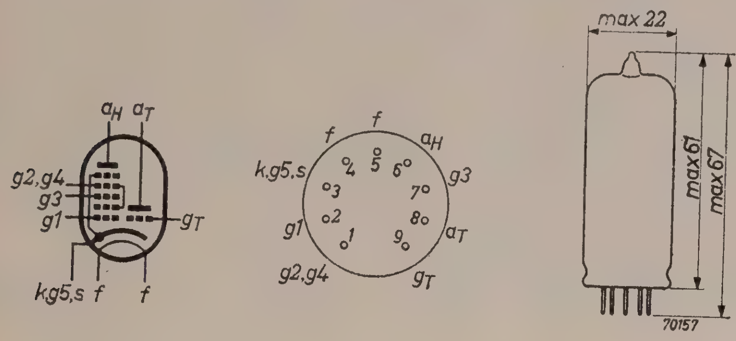
Dimensions and socket connections for the Philips EF85.

made up the total stray capacity, an R.F. of I.F. amplifier using an EF80 would have a voltage amplification of 22 times at a bandwidth of 5 mc/sec. Taking into account unavoidable stray capacities such as the socket capacities, and that of the wiring, a practical figure for the gain/bandwidth product is 55, so that in practice a gain of 11 times can be realized at a bandwidth of 5 mc/sec. It is of interest to note that the gain/bandwidth factor is equally applicable to video amplifiers, such as might be used in a TV receiver, or in a wide-band oscilloscope amplifier, so that for a video bandwidth of 2 mc/sec., for example, the stage gain would be approximately 27 times.

THE EF85

One of the practical difficulties associated with the application of high Gm valves is that, in general, they have a sharp-cut-off characteristic, which means that they are difficult to apply gain control to. Variable grid bias can only be used in conjunction with a simultaneously varied suppressor-grid bias, with the maximum available control bias applied to the latter, and a small fraction (say, one-twentieth) applied to the grid. Automatic or manual gain control in any V.H.F. receiver then becomes a difficult matter, especially when the first stage uses a sharp-cut-off tube in order to achieve the best possible signal-to-noise ratio. For many applications, however, the Philips EF85 will be found to effect a solution to

this problem. It has the very high mutual conductance of 6 ma/v., for a remote-cut-off tube, together with an equivalent noise-resistance of only 2,200 ohms. This is considerably higher than the figure for a sharp-cut-off valve, so that, where the best possible signal-to-noise ratio is needed, in order to obtain the best weak-signal performance, it is preferable to use an EF80 as the R.F. amplifier stage, and effect gain control, either manual or automatic, in the I.F. amplifier, which can contain one or more EF85s.



Dimensions and socket connection for the Philips ECH81.

THE ECH81

Not mentioned so far is the ECH81, which has been designed as a companion type to the EF85. It is a triode-hexode, intended for use as an oscillator-mixer, and its characteristics are such that when it is used in conjunction with an EF85, as either R.F. or I.F. amplifier, the use of a common screen-dropping resistor enables effective gain control to be had with a minimum of cross-modulation and modulation distortion. These valves were originally designed primarily for use in AM/FM receivers, but will find application in other V.H.F. receivers.

THE ECC81

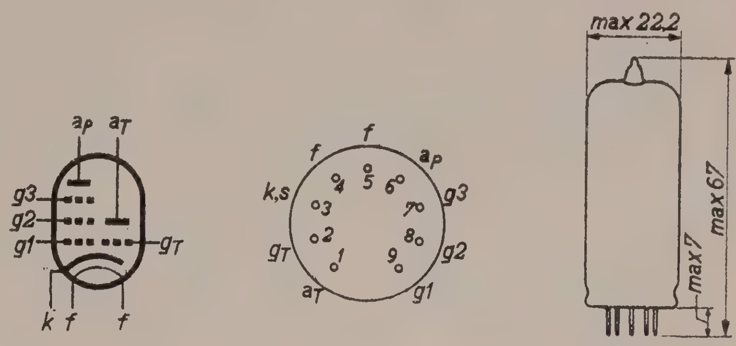
This valve has a large number of possible applications. Both triode sections have identical characteristics, and so the valve is particularly suitable for push-pull applications, whether as an oscillator or amplifier. It can be used in the very popular cascade arrangement, in which one section functions as a grounded cathode amplifier, feeding a grounded grid stage. The first stage is quite stable owing to the very low load impedance represented by the grounded grid stage, and the overall gain is equal to that of a high Gm pentode R.F. stage of comparable bandwidth. The equivalent noise resistance is approximately only half as great, however, so that the receiver noise level can be made almost a quarter as great as when a pentode R.F. amplifier is used.

Another low-noise input stage to which the ECC81 is applicable is the push-pull neutralized amplifier. This circuit is exactly similar to a cross-neutralized push-pull transmitting power amplifier, in which the neutralizing condensers are connected from one plate to the opposite grid, and must be equal in size to the valves' grid-plate capacities.

The ECC81 also makes an excellent oscillator-mixer valve for low-noise V.H.F. receivers. One section is used as the oscillator, and the other as the mixer, with grid injection of the oscillator signal. For the latter, a condenser of from 1 to 5 $\mu\mu$f. can be connected from the grid or plate of the oscillator to the grid of the mixer section, and the resulting frequency changer has the very high conversion conductance of 2 ma/v., together with extremely low noise for a mixer.

THE ECL80

This valve is one of the most versatile ever produced, particularly when applied to television receivers. The pentode section will deliver an audio output of approximately 1.25 watts, so that the ECL80 should prove very attractive as a multi-



Dimensions and socket connection for the Philips ECL80.

purpose valve for small broadcast receivers. At a plate voltage of 250, the H.T. drain is only 16½ ma., total plate and screen, from which it can be seen that for the purpose mentioned it would also be very economical to use. The triode section can be used as a low-gain resistance-coupled amplifier with an amplification of 9 to 10 times. This gain can be used in order to make possible a two-stage audio amplifier, using only one valve, and with enough voltage amplification to enable liberal negative feedback to be used, in the interests of reduced distortion. The triode could otherwise be used as a beat frequency oscillator (in a communications receiver) or as a pre-amplifier, switched into use in the gramophone section of a small radio-gramophone. In oscilloscope circuits, the ECL80 could be used as a multivibrator type of time-base valve, or as a medium-band-width Y-plate amplifier, with the triode used for some quite different purpose, such as a blanking amplifier for blacking out the flyback of the time-base trace. Two ECL80s could be used as a two-stage push-pull amplifier for signal amplification in an oscilloscope.

These notes do no more than indicate some of the possibilities of a few of this remarkable new series. Those readers who desire much fuller application data, together with full characteristic curves and tabulated information, are recommended to write to Philips Electrical Industries of N.Z. Ltd. for the appropriate publications. To conclude this review, we print below a complete list of the World Series TV valves, and the others mentioned above, together with suggestions for their application. These suggestions refer mainly to television, and thus will be of particular interest to those readers who have recently become interested in this fascinating new art.

ECC81:

(1) **R.F. Amp.** p-p grounded grid, cascode, or neutralized p-p stage.

(2) **Oscillator-Mixer.**

(3) **Push-pull Mixer.**

(Continued on page 25.)

The "RADIO and ELECTRONICS" Abstract Service

ANTENNAE AND TRANSMISSION LINES

The design for an aerial for a small yacht or launch is a difficult problem—it means connecting a fairly long-wave low-wattage transmitter to a few feet of radiating material. No single improvement can contribute so much as increasing antenna capacitance to reduce the loading coil. A number of methods of doing this are given, with notes on good insulation and a good ground.

—*Electronics* (U.S.A.), July, 1953, p. 146.

The "plain-ground-plane antenna." These are hard to beat for general-coverage work, but in the ten-metre band they are inclined to get big and a little difficult to handle. The design given overcomes this, and shows a simple and inexpensive way of mounting the components.

QST (U.S.A.), August, 1953, p. 36.

AUDIO EQUIPMENT AND DESIGN

Here is a speaker enclosure called the "EW." Three criteria were set up for the design of the enclosure: 1, small size; 2, smooth response; and 3, high efficiency. In order to increase the length of the air column in the bass-reflex type cabinet, a partition has been set at an angle of 20 degrees to normal. This increases the air column by half without increasing the overall dimensions of the enclosure.

—*Radio and Television News* (U.S.A.), July, 1953, p. 43.

An equalizer-preamplifier: the design has been directed towards a need for a universally applicable instrument of this type. The apparatus has a magnetic pick-up pre-amplifier feeding a two-stage amplifier. Tone controls follow this section into a cathode follower. In addition, there is the sharp cut-out low-pass filter-equalizer, rumble filter, etc.

—*Ibid.*, p. 43.

Inexpensive pick-ups on long-playing records: the reproduction of string tone from these records is often marred by what is best described as "buzz." The article gives a means of overcoming this nuisance by the use of filters constructed from "Ferroxcube" assemblies. These overcome the unwanted resonances in the pick-ups and effect the purpose required at small expense.

—*Wireless World* (Eng.), July, 1953, p. 299.

ELECTRONIC DEVICES

The last war brought the need of teaching Morse to large numbers of men, and it was not easy. For student training, it has been shown that it is a distinct advantage to the learner to hear the code characters transmitted at a speed comparable to that he will encounter in later experience (20 words a minute). A device has been made which will transmit the letters with the adequate spacing between them, and methods of varying the transmission to meet a training schedule.

—*Electronics* (U.S.A.), July, 1953, p. 182.

A V.H.F. radio aid designed for locating the survivors of wrecked aircraft is known as "Sarah," and the apparatus is a small radio beacon, which continues to transmit a pulsed signal until the battery is exhausted. With a comparatively small battery it gives 20 hours continuous operation, and the whole apparatus can be attached to a portable life saver.

—*Wireelss World* (Eng.) August, 1953, p. 381.

INSTRUMENTS AND TEST GEAR

The ohmmeter: despite the fact that the ohmmeter is widely used, there does not seem to be much common appreciation of its finer points. Nor is it always realized that there are two kinds of meter—the series and the shunt. The article deals with basic circuits, effects of battery changes, range changing, and the question of accuracy.

—*Wireless World* (U.S.A.), July, 1953, p. 323.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

All amateurs sometimes wish to wind coils to their own specifications, and usually endeavour to rig up some kind of a machine for this purpose. The primary requirement is that the coils should lie evenly on the bobbin, and this is not easy to achieve. The author has constructed a machine using threaded rods geared to the spindle driving the bobbin to give a controlled movement to the feed of the wires. The gear mechanism is ingenious and simple.

—*Ibid*, p. 377.

Reactivating the dry cell: given certain essential conditions a dry cell can be discharged and reactivated again and again. These conditions are stringent but very interesting. Any reader who is attracted by the problem will find experiments easy and little apparatus required. There is plenty of room for research, and the results may have very useful practical results.

—*Wireless World* (Eng.), August, 1953, p. 344.

During the past few years, considerable attention has been given to the development of various colour cathode-ray tubes. The "Chromatron" is described, developed by Television Laboratories, Inc. The phospor is divided into strips of the primary colours, and as the electrons travel down the tube they are sharply focused by a series of electrostatic lenses. The tubes make use of post acceleration to aluminium backed phospors giving a bright colour picture as well as a black and white picture without loss of detail.

—*Proceedings of the I.R.E.* (U.S.A.), July, 1953, p. 851.

Theory and experimental results are presented for a basically new type of electron-stream amplifier in which the stream flows past a resistive wall. An electron stream floods the pores of a lossy dielectric medium. The gain is obtained through interaction between the stream charge and the wall charge which is introduced by the stream. The wall charge acts upon this to cause larger and larger bunches of electrons to be formed and amplification results. This is an interesting addition to the science of amplification.

—*Ibid.*, p. 865.

RECEIVERS

Full circuit diagram and construction details of a simplified communications receiver. By using commercially available switched coil pack, a good general purpose design in the communication category can easily be constructed. The design incorporates all those refinements normally considered desirable as well as a few not found on several commercial receivers. This appears to be a project well worth while.

—*Short Wave* (Eng.), July, 1953, p. 266.

TRANSMITTERS AND TRANSMITTING

A description of negative feed-back modulation. This is a system of closed-loop modulation which is called the Rothman system, and which utilizes a portion of the transmitter output to provide the power for modulation. The system has high efficiency and ease of tuning, but the system exaggerates non-linearity. A small transmitter is described to demonstrate the principles.

—*QST* (U.S.A.), August, 1953, p. 17.

A multi-band antenna coupler—six bands without coil changing. This solves the problem of the bulky inconvenience of the usual antenna tuner. No plug-in or switched coils are used and only a single split-stator tuning condenser is required to cover all bands from 3.5 to 28 mc/sec.

—*Ibid*, p. 40.

The purpose of the article is to describe the design of a simple 10-metre mobile station. The transmitter requires a minimum of parts for construction and is small enough to fit behind the dash of a car. Power for the transmitter is taken from the vibrator supply, and the available two-watt final plate input power gives performance on a par with that obtainable from higher-powered rigs. No trunk space, dynamotor, separate antenna, or dash to trunk wiring is required.

—*Radio and Television News* (U.S.A.), July, 1953, p. 52.

TELEVISION

Circuit explanation and service data for a new Philco receiver. The article is interesting for its description of the synch. system and the phase comparator for keeping the scanning in phase.

—*Ibid*, June, 1953, p. 58.

Stereoscopic television: many people are now asking, "Why not three-dimensional television?" It is, of course, possible, but such a system would not be compatible with existing systems. But there is a possibility that it can be made available for any new services that may be set up. The article gives the principles of such a system. As far as our own country is concerned, this, or any kind of television seems at present to be far, far away.

—*Wireless World* (Eng.), July, 1953, p. 296.

RADIO & ELECTRONICS TV SUPPLEMENT

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

Television in New Zealand—January, 1954!

By George A. Wooller, Managing Director, Pye (New Zealand), Ltd.

Pye (New Zealand) Ltd. intend to bring television to the public of New Zealand in a series of demonstrations commencing at the Wellington Manufacturers' Association Exhibition, January 7th to 23rd, 1954. With the co-operation of the Minister in Charge of Broadcasting, the New Zealand Broadcasting Service, Post and Telegraph Department, Pye Limited of Cambridge, England, and the Exhibition Committee, arrangements have been completed to demonstrate to people throughout the country the achievements of Pye in the design and manufacture of many types of television equipment.

These demonstrations will feature, for the first time in New Zealand, telecasting as distinct from closed circuit transmission. Several tons of equipment, including a complete camera chain, transmission and full control equipment, as well as several domestic television receiving units are being shipped from Cambridge, England. A TV studio is being built at the Wellington Show and the demonstration will later be a feature of the Auckland Manufacturers' Association 1954 Show, and of other shows throughout New Zealand.

RADIO RECEIVERS

In a little more than twelve months Pye (New Zealand) Limited has produced and marketed in this country a comprehensive range of radio receivers from console-type radio gramophones with fully automatic three-speed playing facilities to portable and bedside-type radios. The exceptionally keen interest of the radio trade and the general public, no less in the superlative quality than in the exceptionally competitive prices, is an indication of the developments yet ahead. The high standard of technical design of all Pye products is world-renowned, and this is understandable when it is realized that the Pye group of companies extends into every field of research, design, and manufacture connected with radio and television.

HISTORY OF PYE

It was in 1896 that the late W. G. Pye founded a scientific instrument company at Cambridge, England. This business prospered and, with the co-operation of the world-famous Cavendish Laboratories, an unequalled range of precision instruments was produced and supplied to laboratories and universities throughout the world. Radio was added to the company's activities at a very early stage (one of the earliest achievements was the production of the first completely portable set in 1922) and in 1930 the nucleus of the present Pye Television Laboratory was established in Cambridge. 1936, the year in which the world's first public television service was opened in London, saw the marketing of the first Pye television sets. Ever since, it has been Pye's consistent policy to devote the maximum effort to television research and development, on both the receiving and transmitting sides.

COLOUR TELEVISION

In 1949, Pye introduced the first colour television system to the public in Great Britain on the occasion of the National Radio Exhibition in London. This equipment was subsequently shown to enthusiastic thousands in Holland and Italy. Full-scale demonstrations of television, using Pye equipment, have also been given in Denmark, Belgium, Australia, Sweden, Canada, Germany, and Eire. A complete demonstration unit was also taken to the United States of America and shown both in Washington and New York. In all these countries the demonstrations met with tremendous success, the experts and the public alike being most impressed by the excellence of the equipment and by the quality of the pictures they saw.

PYE GROUP OF COMPANIES

The vast Pye group today embodies many companies within the Commonwealth. These include Pye Telecommunications, Limited, who manufacture all types of V.H.F. link equipment for military and civil use (represented in New Zealand by Green and Cooper, Ltd.); Cathodeon Limited, manufacturers of cathode ray tubes of all types, glass to metal seals, television camera picture tubes, monoscope type picture generator tubes, crystal quartz units, etc.; Unicam Instruments, Limited, precision manufacturers of X-ray and optical goniometers for the analysis of crystal structure and photoelectric spectrophotometers for ultra-violet visible and infra-red investigations (represented in New Zealand by Geo. W. Wilton and Co., Ltd.); Rees Mace Marine, Limited, a selling and servicing organization specializing in marine installation; Faraday Radio (Gramophones) Limited; Corran Works Limited (Larne, Northern Ireland), manufacturing domestic radio and TV receivers for export throughout the world; W. G. Pye and Co., Limited, precision instrument makers (represented in New Zealand by Geo. W. Wilton and Co., Ltd.); L. G. Hawkins and Co., Ltd., Universal electrical appliances, Hawkins pressure cookers, etc. (represented in New Zealand by Jones, Begg and Co., Ltd.); George Dandridge and Co., Limited; Pamphonic Reproducers Limited, high fidelity sound equipment and special products; T/V. Manufacturing Limited, radio and television manufacturers; Pye Industrial Electronics, electronic devices of all types and R.F. heating equipment. Overseas members of the group are, in addition to Pye (New Zealand) Limited, Pye Canada Limited, Ontario; Pye (Ireland) Limited, Dublin; Pye Radio and Television (South Africa), Limited, Capetown; and Pye-Electronic Pty. Limited, Melbourne.

A recent highly important affiliation is the agreement between Pye Limited of Cambridge, England, and General Precision Laboratory Incorporated (G.P.L.) New York, providing for an expanded programme of joint research and development in the field of industrial and broadcast television cameras and studio equipment. Pye will manufacture cameras and associated studio items in England, and G.P.L. in America, for independent sale through their respective marketing organizations, but the combined engineering knowledge of the two firms, reflecting world-wide operations, will be pooled.—P.B.A.

Great Pye Achievements

During the war years 1939–1945 all the long experience, technical skill and high-quality engineering methods of Pye Ltd., were devoted towards winning victory. To mention but a few of the major achievements in those years, Pye research engineers were the first in the world to develop the proximity fuse of radio-fired anti-aircraft shells. Pye also designed and produced the famous "No. 19" set—the radio receiver-transmitter used in thousands of British and Allied tanks and vehicles. Pye engineers also developed and produced G.C.I.—the equipment by which British night-fighter pilots intercepted and destroyed many enemy raiders during the war.

INDUSTRIAL TELEVISION

The pioneer spirit which has typified Pye's activities since their earliest days is evident in the present-day research and development. At Britain's last radio and television show, held at Earl's Court in London, the Pye remotely-controlled Robot TV Camera was one of the high spots of the show. This equipment, which has been admired by the world's television experts, consists of a swivel-mounted camera operated by a neat "joy-stick" control panel, which can be situated at a considerable distance from the camera. Lens-changing and up, down, and sideways movements of the camera can be made at will.

The Pye Staticon Camera, using a miniature television tube, is another notable advance with far-reaching opportunities in industry and research. The equipment is designed to provide remote observation of industrial processes which may be inaccessible to the human eye, or where close scrutiny would be injurious to the human observer. Such conditions may exist, for example, in a steel foundry, involving heat, glare, and fumes from a furnace. Two main units only are required—the camera which is located close to the subject, and the control and monitor unit on which the observer views the image at a suitable remote point. The television eye may be used also as a valuable substitute in precision engineering observations where it might be advantageous to have the image of the subject enlarged on a screen for viewing by a greater number of persons. It may also be used for time study of diverse operations, remote and local, from a central office, or the combining of several different operations so that one operator controls many. Other fields for the application of industrial television equipment include education purposes in schools and hospitals, and motion picture production, where it is being used for rehearsals in black and white, thus obviating film wastage due to the necessity for retaking scenes. Where there is a need for the instantaneous conveyance of visual information to a remote point, the Pye Staticon Camera system finds an application and results in improved efficiency and economy.

UNDERWATER TELEVISION

An even more dramatic demonstration of the uses of television is the new deep-sea television camera which has been developed by Pye Limited working in close co-operation with the Admiralty. The new equipment is capable of efficient operation at a depth of 1,200 feet, a depth which can be increased to 3,500 feet in the very near future. All optical adjustments can be carried out with ease and precision from the camera control aboard the surface vessel. Complete mechanical control of the camera's direction can be effected from the surface. The camera's angle of elevation through an arc of approximately 115° can also be controlled from the surface, or it may be pre-set before the camera is lowered under water. For purposes of static observation the entire camera unit may be mounted on the sea-bed. The complete Pye deep-sea television chain has been installed in the deep diving vessel H.M.S. *Reclaim* and a similar camera has been supplied to the Admiralty Research Laboratories for experimental work.

COLOUR TELEVISION

The Pye system of colour TV has already proved itself in the fields of medical and dental teaching and has been used at Guy's Hospital and St. Thomas's Hospital in London. Where before only a limited number of students could be admitted into an operating theatre to attend an operation, it is now possible, by the use of colour TV, for practically any number of students to see details of an operation in an adjoining lecture-room. In the field of industrial research, colour TV is also being used to great advantage.

PYE THROUGHOUT THE WORLD

Pye have supplied substantial quantities of television transmission equipment both in England and in the United States of America, where regular television services are in operation. Pye are one of the principal suppliers of television transmission equipment to the B.B.C. in Britain and their cameras, monitors, control equipment, and studio apparatus are in daily use in the B.B.C. studios, at both Alexandra Palace and Lime Grove, London. Pye have also specialized in the design of outside broadcast units, and have supplied the B.B.C. with a number of fully-equipped outside broadcast vehicles. The American Broadcasting Company chose Pye TV equipment for their two new studios in New York. The high-speed production required for the smooth running programmes calls for equipment which is both adaptable and efficient—features which American broadcasting engineers agree are characteristic of Pye products. This installation is one of many using Pye equipment which have now been completed in the United States. Indeed, the demand is so great that each week a consignment of television equipment leaves the Pye Cambridge factory on its way to New York by air. All over the world, in countries where television services are in operation or under construction, Pye equipment is in demand. In Germany, Japan, Belgium, Switzerland, Italy, United States of America, to name but a few, Pye transmission and control equipment, cameras and mobile vehicles are in use.

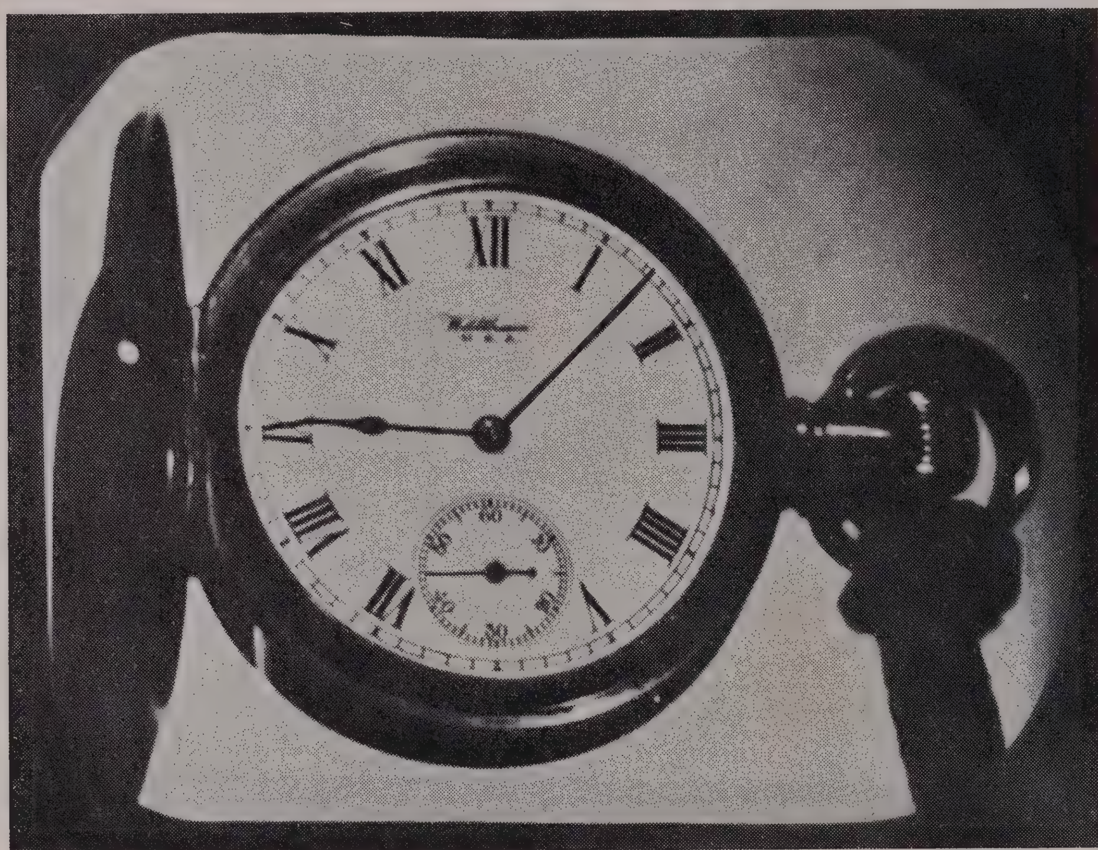
CORONATION TV

Pye equipment played a notable part at the greatest television show on earth—the Coronation of Her Majesty Queen Elizabeth II. An estimated twenty millon people in Britain and a further two million on the Continent, watched scenes televised direct from London. The TV networks of France, Holland, and Western Germany relayed the programmes via an international vision link-up on a scale never before attempted. Again, at the Royal Navy's Coronation Review at Spithead in June, when the Queen reviewed the massed might of the British Fleet from the 1600-ton frigate *Surprise*, Pye equipment played an important part. *Surprise* was equipped with a private radio-telephone line to the shore base at Portsmouth, providing the Royal party with

(Continued on Page 32.)

NEW ZEALAND DESIGNED TELEVISION:

HERE'S A FAMILIAR OBJECT
IN A TWENTIETH - CENTURY PRESENTATION !



A TV RECEIVER IMAGE OF A POCKET WATCH

A Direct Screen Photograph

The illustration shows—far better than wordy opinions—something of the scope of 405-line TV in its ability to reproduce detail.

IT DISCLOSES, ALSO, THE PIONEERING EFFORT OF A NEW ZEALAND COMPANY TO BE ABREAST OF THIS NEW ART, AND THE EXTENT OF ITS "KNOW-HOW" IN PRACTICAL TELEVISION TRANSMISSION AND RECEPTION.

FOR THE TECHNICALLY MINDED.

Transmitted on 96.42 mc/sec.
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RESEARCH AND DEVELOPMENT FOR OVER A QUARTER CENTURY

EDITORIAL

This supplement to *Radio and Electronics* has been prepared with a special purpose in view. As yet, television has not come to New Zealand, but there are few of us in the radio industry who do not hope that the day of its advent will not be long delayed. Television is one of the "babies" of electrical engineering, in that it is only sixteen years since the first public service of TV programmes was instituted. In that sixteen years, broken as it was by the second world war, TV has flourished exceedingly, not only in Britain, which pioneered it, but also in the United States of America, South America and the Continent. TV is one thing which gives the lie to those who maintain that Britain no longer has the ability to lead the world, for not only was London the first city in the world to have TV broadcasting, back in 1937, but since the war, the B.B.C. have gone ahead with their plans for covering the country, and now 95 per cent. of the people in the British Isles are covered by the network of high-powered television stations that has been set up. In addition to this, Britain has kept herself well in the forefront of technical developments, and produces transmitting equipment second to none in the world. We all know how the U.S.A. prides itself on its technological achievements! It is surely a feather in the caps of British engineers and producers of equipment, that British studio and transmitting equipment is being sold to American television broadcasters.

We, too, belong to the British Empire, and have gained somewhat of a reputation for initiative and resource; this Television Supplement shows the whole country, and not just the radio industry (who in general know it already) that New Zealand manufacturers, educational institutions, and business houses have not been content to wait meekly for a sign from the Powers-that-be, before thinking about television. Many of them have done much more than think, as these pages will show. That this Supplement has been possible AT THIS STAGE is in itself a tribute to our radio industry, and an earnest to the public that the industry will not be found wanting when it comes to preparedness and action in the matter of TV.

Managing and Technical Director:
W. D. FOSTER, B.Sc.

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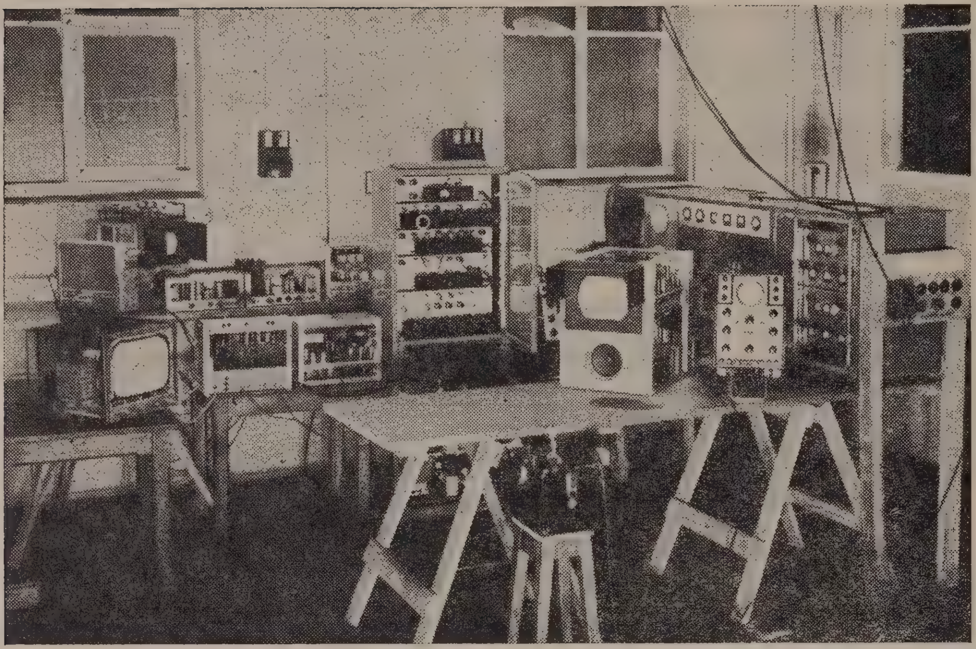
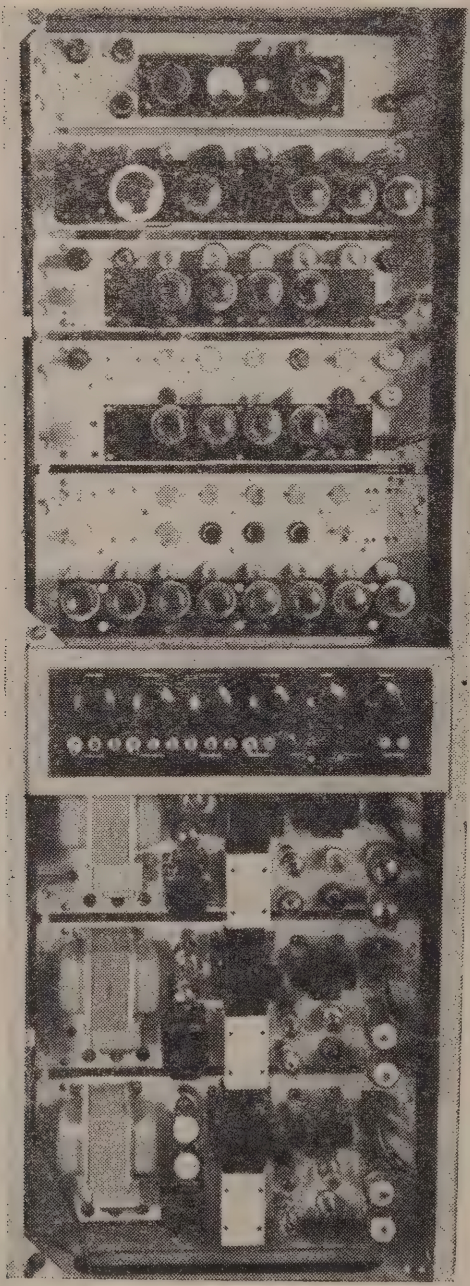
CONTENTS



Perhaps the most significant television work that has yet been carried out in this country is the project which is being carried on in the Electronics Laboratory at the Canterbury College School of Engineering. In November of last year, this journal had occasion to comment editorially on this work, which, apart from its great value to the Engineering School, is noteworthy as the first recorded transmission of high-definition television signals to take place in New Zealand. Nor is it pure coincidence that the view through the Electronics Laboratory's window into the quadrangle—one which by now has become very familiar to those in Christchurch who have built or acquired TV receivers—is literally only a stone's throw from a memorial plaque commemorating Lord Rutherford's earliest research work, which was done in the Physics Department at Canterbury College. The subject of that research, it might be mentioned, was radio!



PURPOSE OF THE C.U.C. PROJECT

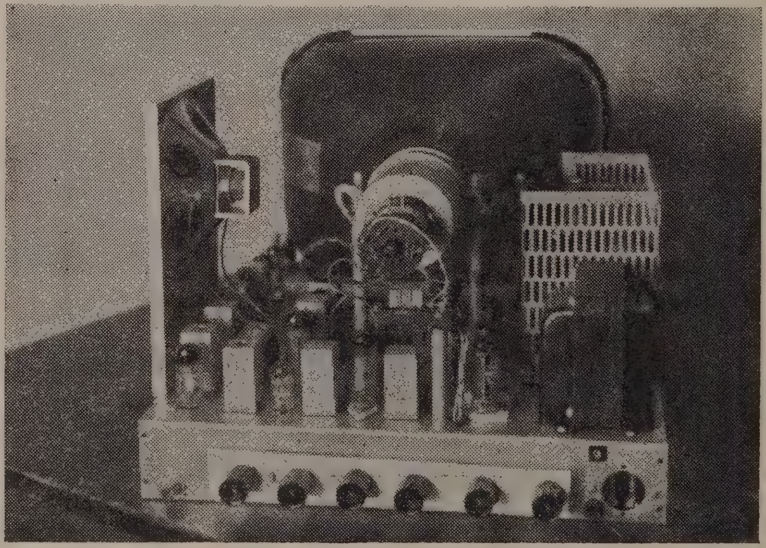
Before going on to say something about the equipment itself, we should set down the aims of those who conceived the idea, and who have since been prosecuting it with much enthusiasm and vigour. Needless to say, those aims are educational, as befits work which goes on within the precincts of a university, but this is not Education, with a capital E, such as connotes (at least to the layman) dry-as-dust theories which do not always seem to work in practice. Far from it, for this is one manifestation of education at its best, and at almost its highest level. Let us explain.

The project comes under the jurisdiction of Professor McElwee, Professor of Electrical Engineering, and the detailed supervision, planning, and execution, has been carried out by Mr. B. T. Withers,

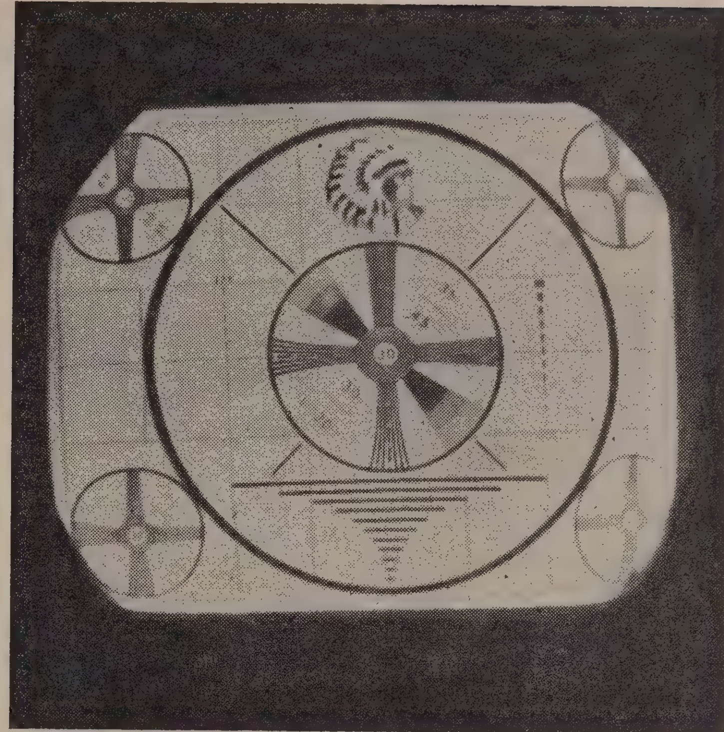
Above: General view of the TV equipment in the Electronics Laboratory. The camera can be seen immediately above the receiver in the left-hand corner of the picture. The wooden rack at the right houses the transmitter, while the remainder of the equipment visible comprises the synchronizing and signal-handling circuits, together with a monitor, a second receiver, and a waveform oscilloscope.

Left: The rack containing the synchronizing signal generator and video mixing panel, together with their regulated power supplies.

Below: One of the complete receivers constructed at C.U.C.



TV at Canterbury University College



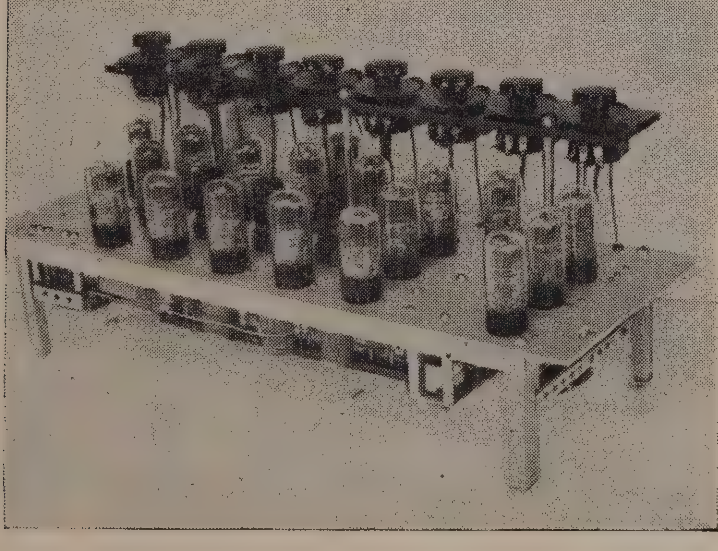
one of his senior lecturers. There are two main ideas which were decisive in translating the project from an enticing scheme into actuality. The first is that each department of an institution like the Engineering School must have at its command material which can form the basis of the research work that candidates for honours degrees must carry out as part of their honours course.

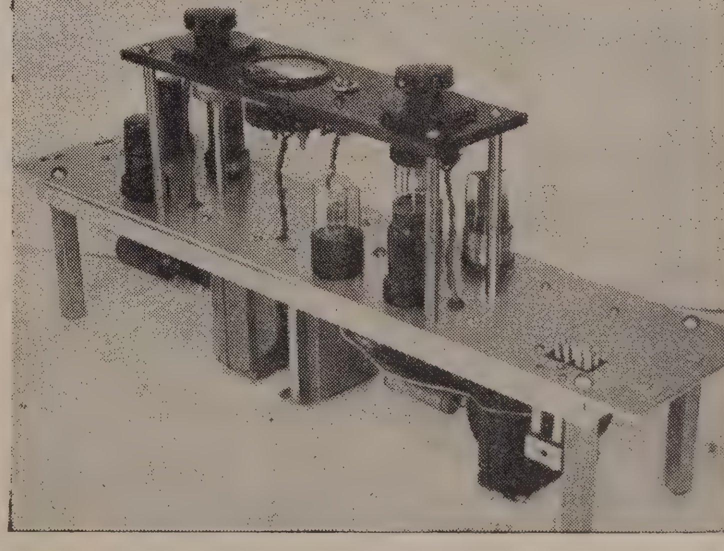
Now television is undoubtedly the most rapidly advancing of all branches of electrical engineering. It therefore makes one ideal field for honours students' research, for in spite of the admittedly high standard of technical achievement represented by current television practice, many weighty problems remain to be solved, and many "standard" techniques are capable of being improved. Then again, television embraces in some degree the techniques of all branches of electrical engineering, not to mention that it also embodies the direct application of a remarkably wide range of physical phenomena. What could be better, then, for the purpose under discussion? And what subject could be better calculated to hold the interest of some of the best young brains in the country?

This brings us to the second, and perhaps more important function of the television activity at the College, as envisaged by the two men we have mentioned. As they see it, it is the duty of the Engineering School not only to offer its undergraduates the bait of the letters B.E., to be added to their signatures after the requisite examinations have been passed, but also to hold and develop the enthusiasm of the students for their chosen subject, and to fire their imaginations by providing for them exciting and absorbing prospects. There can be little doubt that the TV project does just this. Please note that only those of Honours standard among students of electrical engineering are able to work on it. A student must prove himself capable of undertaking an honours degree with every chance of success before he is allotted a portion of the television work to carry out, and on which to write a thesis at its completion. It is something that is exciting and new that the first-year student sees going on next door to his own elementary labours, and that is an incentive to him to do more than just "scrape a pass." It is a "live" subject among much that, while essential, cannot help at times from being dull or drudgery. Who knows? The work in this Electronics Lab. may well be the means of leading some brilliant student towards momentous discoveries,

Above: Photograph direct from the monitor tube's screen of a monoscope test pattern. The distortion in the corners is due mostly to the fact that the pattern is occupying the maximum usable area of a round 7 in. tube. Linearity and resolution can both be seen to be excellent, while the rather poor focus is due to the photography, and not to lack of focus in the display itself.

Below: Two of the units removed from the main rack, showing the style of construction used. Note how accessibility is provided, both for changing tubes, from the front, and for working on the circuitry, from the back, with the equipment actually operating.





even as Rutherford who worked at radio in this same College before branching off into the wider sphere of atomic physics!

Be that as it may, the fact remains that Professor McElwee and Mr. Withers should go down in history as men of the broadest vision in the teaching of electrical engineering, who have done much for which the radio industry should be grateful.

In case anyone should think that the C.U.C. project has any bearing at all on the radio industry's present preoccupation with the advent of television broadcasting in New Zealand, it should be pointed out that the idea was formulated as long ago as 1949—at a time when the same radio industry was not at all in favour of TV as a topic of conversation, let alone of publicity! That the first pictures were transmitted in 1951, and that experimental transmissions have been going on ever since, are facts which have not the slightest bearing on the subject of this special issue. Indeed, in conversation with Mr. Withers, one gathers that in some ways at least, he could wish that no one outside the walls of the university had ever heard of his endeavours! This is partly modesty, and partly a desire to escape from a multitude of telephone calls from members of the public who want to know (a) can they buy a television set that will receive his transmissions; (b) if they bring one in from England, will it pick up his station; or (c) would he make the necessary modifications to a set they already have. It is also part of the university man's horror of becoming embroiled in anything that smacks of politics. All this, however, did not prevent either of the two gentlemen we have mentioned from acceding to the writer's request to visit the laboratory for two days in order to obtain material for this article, or from affording him every facility not only to do this, but also to further his own studies in the matter of television by spending valuable time with him discussing the technical features of the equipment which is illustrated on these pages.

THE EQUIPMENT

As might be expected, the equipment that has been built as the project moved along is in many respects highly original. The largest single unit is the rack containing the synchronizing signal generator and the video mixing circuits. The synch. generator is probably unique, in that merely by adjusting the many controls, it is capable of being made to work according to any desired set of TV standards, from the British 405-line system to the French 819 line standard. It is possible, too, of course, to set up any of the systems that might be thought of which have a number of lines per picture between these limits. It has been made in this way so that systematic experiments can be undertaken in comparing the actual performance of systems operating on any possible specification. For example, it would be possible to investigate the operational differences between any of the systems in actual use. It would also be possible to make experiments to determine the effect of altering a standard specification in one major respect, as for instance, if the British system were operated with negative modulation instead of positive, everything else remaining unchanged. The design of such a versatile synchronizing generator posed several problems not met with in an equipment which is designed for a particular standard, and the overcoming of these difficulties has been part of the task set the students who have had the job of designing the several sub-sections. One man, for example, was responsible for designing and building the master oscillator and its automatic frequency control equipment, while another was responsible for the frequency dividers.

One aspect of TV transmission which has not hitherto received as much attention from engineers as it might is that of providing a flexible control over the contrast of the transmitted picture. This is one of the "unsolved" problems which Mr. Wtihers and his men have attacked in an original way, and Mr. Withers is preparing a paper for publication in an overseas journal, embodying his findings.

The receivers that have been built are also capable of working on several of the standard systems. One of these is illustrated here.

The camera that has been used so far uses an R.C.A. 5527 iconoscope, which is a small tube, electrostatically deflected and focused, which was designed primarily for industrial television systems. It is capable of excellent resolution, however, and the results to be seen on the monitor display unit are fully up to the best capabilities of the 405-line system which was the one in use when the writer saw it. There is also a monoscope camera, which produces the well-known "Indian Head" pattern, a reproduction of which is shown here. The laboratory has received a generous gift of two of the most recently developed British camera tubes, namely C.P.S. Emitrons. A camera to take these tubes is at present under construction, and it is hoped to have it working towards the end of this year.

The transmitter for the video signal uses a pair of NT98 tubes as a push-pull grid-modulated final amplifier and this is driven by a QQE06/40. The maximum possible power output is quite high, but the transmitter is run at a peak power of 200 watts at times, and at others a peak power of approximately 20 watts is used by disconnecting the NT98s and using the driver stage as a modulated amplifier. True vestigal sideband transmission is not used but, in the interest of improving the quality of the superior sideband, the inferior sideband is attenuated by means of final amplifier-aerial adjustments. Receivers have standard vestigal sideband adjustments and operate on the superior sideband. A separate sound transmitter is used, and its output combined with that of the video transmitter at the aerial array.

Without embarking on a long and fairly complete technical description, which would be out of place here, there is not a great deal more than can be said about the equipment itself. The photographs reproduced here give a very good idea of the workmanlike manner in which the gear has been constructed. The wiring of all units in the main rack is accessible from behind, so that performance checking and fault-finding can readily be carried out while everything is running. Mechanically, the equipment is remarkably well designed, and should be an object lesson to the many who will be faced with constructing similar, if less ambitious, gear for factory production testing and similar purposes.

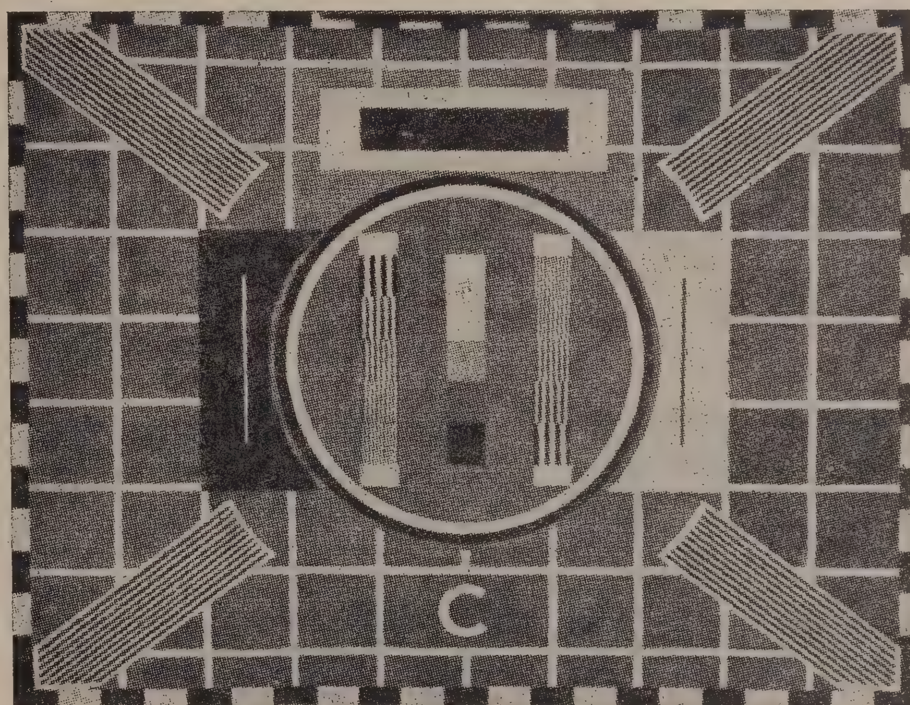
In conclusion, we would like to extend our thanks and that of our readers to Professor McElwee and Mr. Withers for their assistance and co-operation which was so freely tendered to us in preparing this article. We trust that we have given not only some idea of the most interesting work that has been going on in the C.U.C. School of Engineering, but also an appreciation of the importance of the project to its students, and indirectly to the radio industry of this country.

A Television Test Card—And How To Use It

Those readers who have dipped into the odd TV text-book will doubtless have seen specimens of the test charts which stations transmit at times, or which are used in factories and laboratories for evaluating the performance of receivers. The following article describes one such chart in detail, and illustrates what an exceedingly useful pattern it is for technical men, even though its value as programme material has obvious limitations!

The television test card "C", which is radiated by the B.B.C. television service during the 10 a.m. to 12 noon period, is of great value to dealers and engineers engaged in service and maintenance work in Britain. The card was introduced as a result of the close liaison which B.R.E.M.A. maintains with the B.B.C. on technical matters relating to television.

It was designed jointly by the two organizations to overcome the limitations of the original test card "A" from the point of view of those concerned with the design, development, and maintenance of television receivers. The following explanatory notes are of interest.



1.—GENERAL

The pattern approximates in mean signal to that of the average picture. The general background of the whole pattern is made mean grey to enable both positive and negative high frequency overswing, and similar effects, to be observed at the correct setting of the brightness level and in the form in which they are usually most noticeable on picture transmissions.

Areas of mean grey background are left between all sections of the test pattern to enable "following" effects to be observed and in order to avoid, as far as possible, interference between different tests.

The main frequency and contrast range tests are confined to the area of the pattern within the centre circle where the focus quality should be a maximum. Subsidiary focus tests are provided in the corners of the pattern.

An outer border of black and white sections similar to that used in Test Card "A" has been retained.

The individual test sections and their uses are dealt with in more detail below.

2.—HIGH FREQUENCY RESPONSE

The two frequency test patterns within the centre circle consist of five frequency gratings corresponding to fundamental frequencies of 1.0, 1.5, 2.0, 2.5, and 3.0 mc/sec. They are arranged vertically for ease of intercomparison and are provided with white reference areas at the top and bottom to aid in assessing the reproduced level of modulation in the grating. The two patterns are reversed vertically relative to each other to reduce effects of non-conformity of cathode-ray tube focus and effects arising from other parts of the whole test pattern.

In use in receiver checking, referring to the left-hand pattern, the top three frequencies, 1.0, 1.5, 2.0 mc/sec., should certainly be resolved, and, in the later designs of receiver, the 2.5 mc/sec. pattern also, although with reduced intensity of modulation. It is unlikely that significant resolution of the last pattern will normally be obtained, since the frequency is outside the range for which most receivers are designed.

3.—FOCUS UNIFORMITY

Additional diagonal frequency gratings are provided in the corners of the pattern and extend over that part of the picture area where focus variation is most significant. The equivalent horizontal definition of these gratings corresponds to a fundamental frequency of about 1 mc/sec. and should be well within the response of the amplifier circuits. The variation of cathode-ray tube focus, or optical focus in projection systems, over the picture area can, however, still be judged by observation of the sharpness of the lines of the gratings.

4.—LINEARITY OF SCAN

The majority of the pattern is covered by a white square grid on the grey background. This provides a means of judging scan linearity over the major part of the picture area for both directions of scan. In addition, a more critical test of linearity over the central area is provided by a centre circle of slightly larger diameter than that on test card "A"; the grid is therefore omitted from the area inside the circle.

For perfect linearity of scan the circle would be

accurately circular and all the grid meshes square and equal in size. A close approximation of this can usually be obtained with present receivers (see also section 5 below).

5.—PICTURE ASPECT RATIO

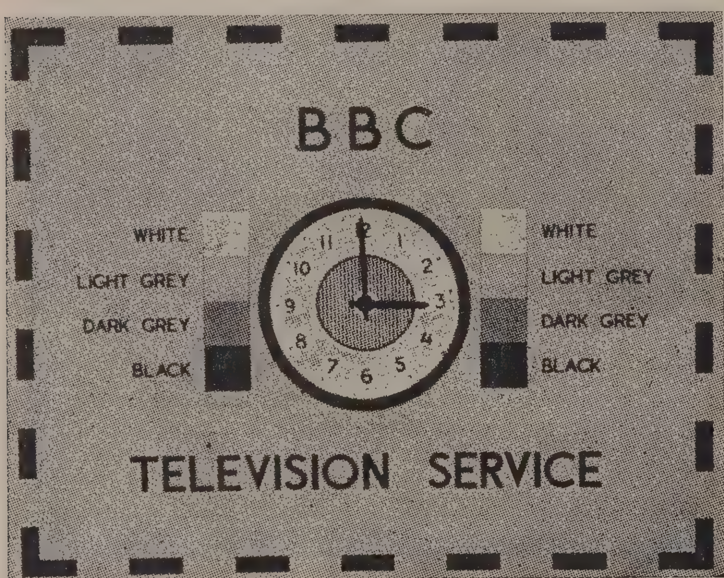
The pattern is surrounded by a border of alternate black and white sections the length of each section being half that of the mesh of the linearity grid.

The outer edges of this border represent the boundaries of the transmitted picture, and therefore have an aspect ratio of 5 to 4. Under correct scan amplitude adjustment these outer edges should just fill the receiver mask. In practice it may be found that it is not possible to fulfil this condition exactly with optimum linearity in the centre of the picture, as judged by the circle. In this case it is probably preferable slightly to overscan in either the horizontal or the vertical direction in order to maintain central linearity.

6.—SYNCHRONIZING SIGNAL SEPARATION

The black and white border sections on the right-hand side of the picture, immediately preceding the line synchronizing impulses, also afford a critical test of separation of synchronizing impulses from picture signal.

Incorrect adjustment of the synchronizing separator or



The B.B.C. tuning test car—less complicated than Test Card C—which is radiated before each transmission to enable viewers to adjust their sets before the programme starts.

limitation of frequency response in the vision channel will tend to cause horizontal displacement of parts of the picture information, e.g., the contour of the circle, corresponding to the positions of the black and white sections down the height of the pattern.

7.—CONTRAST RANGE

The central contrast wedge provides five tone values varying between full white at the top to black at the bottom. It is not at present possible to specify the brightness of the intermediate tones exactly, but with satisfactory receiver operation they should all be reproduced as definite steps in brightness.

For satisfactory receiver operation the brightness and contrast controls should be adjusted so that the scan is just not visible on the black square, while the white square represents the maximum brightness available from the tube at satisfactory focus quality.

If one of the intermediate tones is missing, or the grading appears unequal, it will, in general, be necessary to reduce the contrast, and reset the brightness to give the correct black level.

8.—PULSE RESPONSE AND SPURIOUS ECHOES

Two vertical bars, one white and the other black, of about 0.25 microsecond width, are provided on either side of the centre circle. These provide in effect a pulse test of the whole system and enable the response to isolated detail approaching the maximum resolution of the system to be judged.

In addition, these bars provide a means of checking the presence of spurious reflection signals such as those arriving at the aerial by multipath transmission.

9.—LOW FREQUENCY RESPONSE

Amplitude and phase distortion at the low frequency end of the video spectrum give rise to background shading over the picture area in the form of horizontal streaking effects. Such effects, however, are infrequent as a form of receiver distortion and could only occur where one or more stages of video amplification with unsuitable L.F. time constants are employed; such effects may also be caused by faulty D.C. restoration. The fault is, however, more likely to occur at the transmitter, due to the difficulty of maintaining accurately a perfect L.F. response to the transmission system.

An adequate test for practical purposes is provided by the black bar on a white ground positioned above the centre circle, and in addition, the black and white areas on either side of the centre circle.

10.—MISCELLANEOUS POINTS

The grid pattern has been made to correspond to a full white signal in order to provide an additional check on the variation of focus quality over the picture area at maximum cathode-ray tube modulation. For this purpose, the lines of the grid have been made as narrow as permissible without appreciable introduction of the interference effects on horizontal lines, inherent in the line scanning process.

RAPID GROWTH OF TELESURANCE

A "Health Scheme" for television sets, was a recent description of his company's activities, given by Mr. H. A. Curtis of Telesurance Ltd., England, which provides television maintenance insurance through R.T.R.A. dealers. Over 2,000 members of the R.T.R.A. are now agents for the Telesurance scheme.

This company was formed in August 1950 to satisfy the growing need of R.T.R.A. members for organized assistance with maintenance agreements between themselves and their clients in respect of television receivers.

At first, it was uncertain what response would be forthcoming from the public and the trade. Each month, however, has brought a steady increase in the number of policies issued and of agents actively participating in the scheme. The annual premium income of the company is now approaching a quarter of a million pounds. Each year thousands of cathode-ray tubes are replaced, and tens of thousands of claims are met for valves and other components.

The Telesurance scheme is now being advertised nationally to the public in Great Britain. To the dealer it has many attractions, not the least being that it gives him a regular service income and enables him to plan his service department accordingly.

What Are We Doing In Preparation For Television?

By L. E. MAYO, Graduate I.E.E., Radio (1936), Ltd.

A brief survey of some of the preparatory work that can be undertaken by individuals and organizations, before a television service is started, to gain the technical skills needed for the manufacture and servicing of television equipment.

For several years now the establishment of TV service in New Zealand, and in Australia, has been just around one of those elusive corners which seem to recede like the foot of the rainbow.

It is some time since Australia announced the standards for a service in that country and called for tenders for transmitting equipment. Economic and political considerations intervened, however, and although a Commission is deliberating the position, there is little indication of the early establishment of an actual service.

Similarly in New Zealand, though interest in TV has been widespread for some time, no one can say how long it will be before TV will be on the air. In the meantime, there is much that can be done by those in the trade and the industrial field in preparation for the day when TV is a reality—indeed, there is much that is already being done by workers in different parts of the country.

Most of the larger radio manufacturers in New Zealand are likely to be associated with an overseas TV manufacturer, so that in the earlier stages at least, the receivers built here will be based on overseas designs, but factory technicians and servicemen will need to prepare themselves for the new techniques, and should make the best possible use of the remaining time. Let us consider some of the ways in which this can be done.

Mr. R. J. Orbell (right) Chief Engineer of Radio (1936) Ltd. discusses a technical detail with Mr. L. E. Mayo, Laboratory Engineer.

The television processes are so much more complex than those of radio that from the start we must face the fact that theory and practice must go hand in hand. This is not to say that we cannot derive much benefit from reading some of the excellent textbooks on the subject or from a correspondence course, but to attempt to learn all about television from books is about as hopeful as to try to learn to swim without going into the water.

On the other hand there is not much practical work that can be undertaken in TV without a reasonable understanding of the theory—there seems to be little likelihood of a TV "Hiker's One."

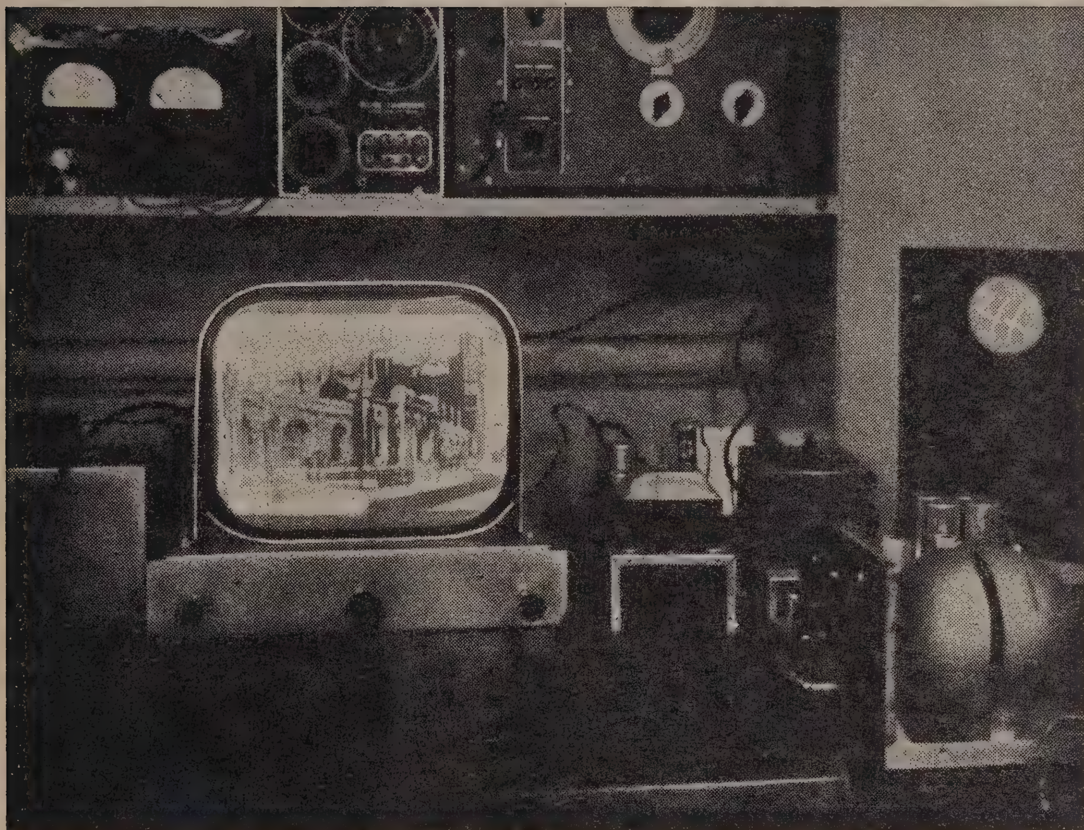
To individuals without considerable resources in time and money the courses that have been, or are soon to be, started in the technical colleges in the larger cities can be commended, as offering to all who can attend a good combination of theoretical and practical training at little or no cost. For those whose resources and opportunities are greater, there is a bewildering array of practical projects which can be undertaken, ranging from simple experiments in pulse and video circuit techniques up to the most elaborate assembly of transmitting equipment.

Probably the first essential before any useful work can be done is a cathode ray oscilloscope. Much can be done with only a simple type as most of the pulse circuits used in TV operate at moderately high signal levels and require little further amplification in the oscilloscope, and time base frequencies do not usually require to be higher than 10 or 20 kc/sec.

Naturally the extra facilities provided on the more elaborate commercial instruments are very desirable and for more advanced work on pulse and video equipment, wide band amplifiers, calibrated amplifiers and time bases and other features, increase greatly the usefulness of the instrument. Often it is extremely helpful to display waveforms from two parts of a circuit simultaneously and for this purpose either an electronic switch or a double beam oscillograph may be used. The radioman who has no experience of the oscilloscope and who wishes to equip himself, educationally and practically, for TV might be well advised to construct himself such an instrument.

One of the differences between the ordinary radio receiver and the TV set that soon becomes apparent to the tester or the serviceman lies in the alignment of the I.F. amplifier, which must be adjusted for a uniform response over a range or bandwidth of several megacycles. Alignment of a wide band I.F. amplifier can be carried out by the laborious method of testing and plotting point by point, but a much more efficient method is to use the oscilloscope and one of the comparatively simple frequency sweep oscillators, or "wobbulators." These are designed to supply a signal which is rapidly varied over the required band of frequency many times each second, while the oscilloscope displays the selectivity curve of the amplifier under test, enabling the result of any adjustment to be observed instantly.

The experimenter in TV, be he amateur or professional, will, of course, not be satisfied until he has reproduced some sort of picture. A complete TV camera, even one using one of the simpler and cheaper iconoscope camera tubes, is likely to be too elaborate and expensive an item for any but a fairly large organization to undertake, but there are two other methods of obtaining a picture. The first of these is a picture



FIRST EXPERIMENTAL RESULTS

This photograph, which was taken just after the initial rough adjustments had been made and the first picture appeared on the screen, illustrates the first experimental equipment put into operation by Radio (1936) Ltd. approximately two years ago.

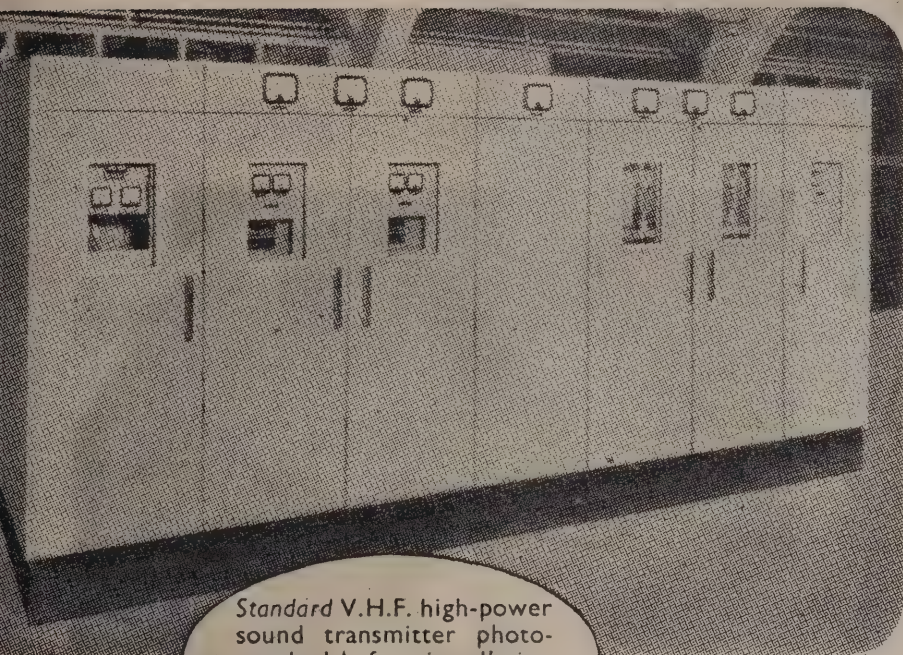
generator tube of the monoscope type. This consists of a special cathode ray tube with a special picture or pattern mounted permanently inside it instead of the usual fluorescent screen. The light and dark areas of the picture are so treated that the number of secondary electrons liberated by the impact of the electron beam, as it scans the area of the picture, varies according to the density of each element of the picture. Thus a picture signal is produced in a similar manner to the camera tube, but the picture is fixed and cannot be changed. The cost of one of these tubes is, however, quite high, and while in simplicity, compactness, and resolving power, they are much preferable to a cheap type of camera for purely experimental and testing purposes, the inability to change the picture or pattern is a serious drawback for other uses.

The other alternative for the experimenter is to build some form of flying spot scanner which can be used to reproduce pictures from photographic transparencies. This device has been made more popular by the availability of the war surplus 5FP7A radar tube at low cost, and has been well treated in the technical journals. Many experimenters have constructed these units and have had interesting and valuable experience, but the surplus radar tube has the limitation that the short persistence phosphor which is required to produce a true flying spot, free from appreciable tail, is overlaid by a long persistence coating which, while its light output is almost equivalent to a D.C. component and thus does not greatly affect picture detail, forms a rather coarse and blotchy screen and thus limits the picture quality that can be obtained.

Special tubes are made for flying spot scanning, intended for transmission from cinema film, and these are capable of very good results but are not so easily obtainable. The American types 5WP15 and 5ZP16 are typical examples. For best results voltages of 20,000

(Continued on Page 32.)

o Britain's Television Network



Standard V.H.F. high-power sound transmitter photographed before installation at Kirk o' Shotts. A similar transmitter is installed at Wenvoe.

The Microwave Television Link installed between Manchester and Kirk o' Shotts, a distance of approximately 250 miles, employs beamed transmissions over line-of-sight paths. Seven repeaters, the antennæ of one of which is shown above, relay programmes in either direction.

Brimar also aids Cross-Channel TV

In 1950 Brimar played an important role in the *first* modern television pictures transmitted by the B.B.C. from Calais.

In 1931, S.T.C. demonstrated the *first* micro-
radio telephone—in 1934 the *first* commercial link
established, and then the *first* cross-Channel TV.

milestones in history for S.T.C. and *Brimar Valves*
were chosen for their reliable past.

ar Valves too, were chosen by most of the world's
tic radio installations—B.B.C.—Eiffel Tower—the
n Mary, and *Queen Elizabeth's* radio—famous world
airways radio, including the new Comet.

vonder *Brimar's* world reputation for top efficiency,
high reliability is unassailable!

n Television comes to New Zealand BRIMAR will play their full part.

RADIO VALVES **BRIMAR** TELETUBES

LINGTON, BOX 593 • CHRISTCHURCH, BOX 983 • WANGANUI, BOX 293.

Television Manufacture and Service—Plant and Personnel Requirements

C. A. PEARSON

Production Manager, Dominion Radio and Electrical Corporation, Ltd., Auckland

MANUFACTURE

It is of interest to consider the staff and test equipment used in a leading American manufacturer's production pilot plant. These plants are self-contained pre-fabricated units, each capable of producing 200 television receivers per week. This excludes the manufacture of specialized component parts such as tubes, resistors, condensers, etc., but includes parts similar to those now fabricated by the majority of New Zealand manufacturers.

A pilot plant is normally established as a prototype production unit in markets where a television service is about to commence operation. Being a self-contained unit, the plant provides an efficient core which can be readily expanded as demand determines.

Building requirements are based on 125 sq. ft. of floor space per productive worker, plus a storage allowance equal to 50 per cent. of annual finished product cubic volume. Maximum use is made of natural lighting and the amount of glass used represents an area equal to 75 per cent. of floor space.

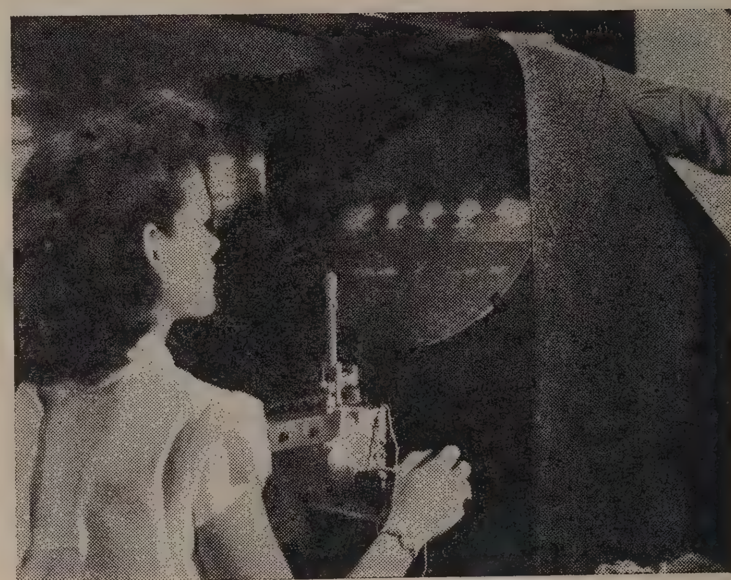
The most recently erected pilot plant was established in Brazil. The following staff complement was necessary for the manufacture of 200 multi-channel TV receivers per week:—

ASSEMBLY

	Female	Male
Fabrication of parts	12	6
Assembly, hand and air gun	9	6
Wiring only	20	
Wiring and soldering	6	
Soldering only	8	
Relief operators		3
Inspectors, main and sub-assembly	5	
Continuity checkers	2	
Inspection, finished product		1
Inspection, cabinet		1
Packing, dispatch, and store		4
TEST AND FACTORY SERVICE		
Continuity fault men		1
Technical service and engineering		3
Technical test		6
Cabinet repairman		1
Quality controller		1
Trucker		1
	62	34

Specific items and quantities of test equipment are as under:—

6-Range ohmmeter	4
12-channel television transmitter	5
Multi-frequency generator	2
12-channel wobbulator	3
Power-deflection chassis	4
R.F. chassis	4
C.R.T. assembly	5
Power supply	4

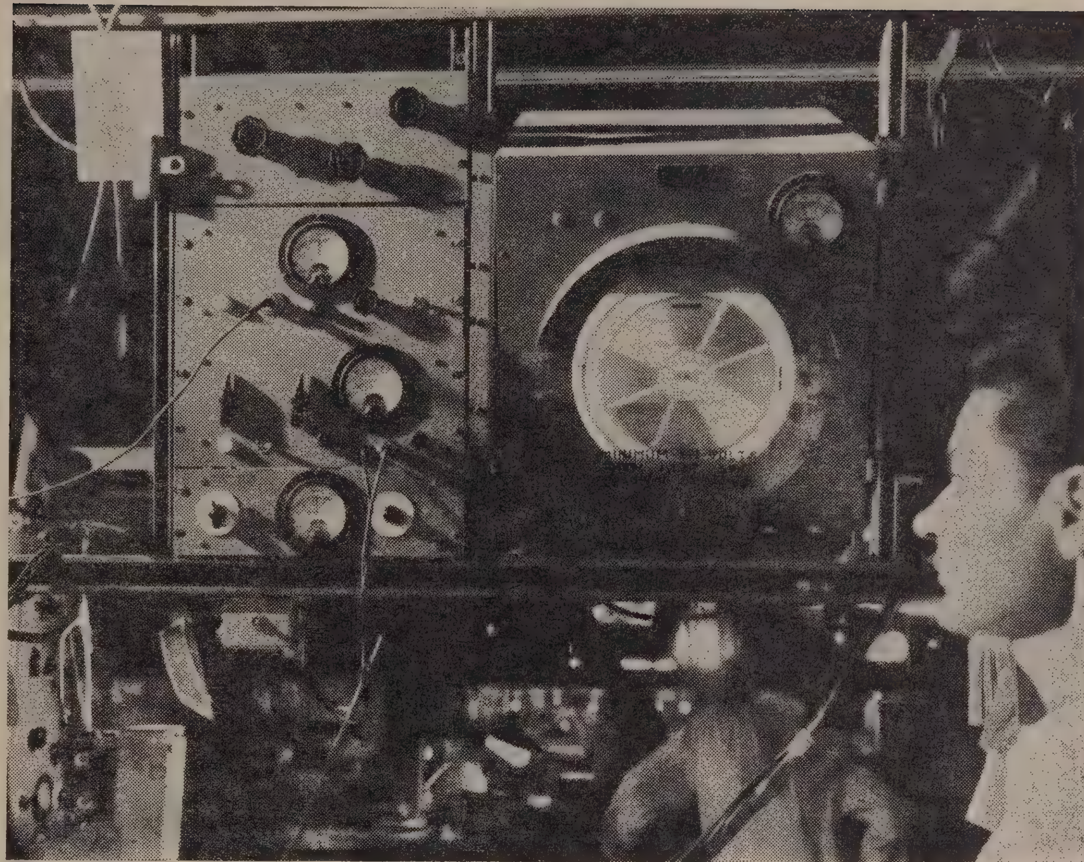


Production type comparator test equipment checks R.F. turret tuner switch contacts before mounting sub-assembly on receiver chassis.

Overload indicator	1
Insulation transformer*	25
Speaker	2
Volt-ohmmeter	8
Oscilloscope	4
V.T.V.M.	2
F.M. signal generator	2
Univerter	2
Output meter	2
Distortion meter	1
R.F. attenuator	3
Signal selector	1
T.V.A.	2
Square-wave generator	2
Oscilloscope	2
Audio oscillator	2
R.F. oscillator 67.25 mc/sec.	2
Electrostatic voltmeter	3
Distortion meter	1
Variac	5
Test panel A	2
Test panel B	2
Test panel C	1
Test panel D	1
Antenna jig	7
Ground and short test	2
Marker jig	5
Video output jig	3
I.F. jig	2
Discriminator jig	3
Sound input jig	2
A.G.C. jig	2
C.R.T. jig	2
Discriminator and output jig	1
Video input jig	3

Speaker jig 22
Micro-ammeter 0–500 μA. 1
Record-changer 1
Cables
Batteries, 4.5v. 9.0v. 22.5v.
Tube holders 5
Synchronizer 1
Monoscope 1
Video distribution amplifier 2
Voltage regulator 1
Calibrator 1
Rack 19 in. x 6 ft 1

*Includes transformers required for heat run.



Cathode ray tubes are taken from shipping cartons and placed in frames prior to being aligned by mirrors. Tubes then go into television sets on assembly line in Philco Corporation's new radio and television plant.

SERVICE

Television service carries with it an urgency and importance far greater than that found in radio or even refrigeration. Bad TV service shows up very fast, causes a lot of trouble and costs a lot of money. It is the responsibility of manufacturer and dealer alike to have trained staff and adequate facilities available immediately television commences operation in his area.

Two-man mobile installation crews will be necessary for original set and aerial installations. The senior member should be a competent man familiar with the sets being installed. With an unskilled assistant five installations a day can be averaged.

It will be essential to have well-trained field technicians available to undertake repairs in the customer's home. One field technician will be required for every three to four hundred sets sold.

For those sets which cannot be repaired at the customer's house, shop technicians will be needed. The ratio of one shop technician to every four field technicians will be found most practical.

Staff and test equipment requirements based on the sale of 1250 television sets during the first year should approximate:—

Supervision

1 service manager (part duties).
1 stenographer (part duties).
1 stock and storeman (part duties).

Repair and Installation

1 installation crew.
1 shop technician.
3 field technicians.

Test Equipment

Shop equipment (per technician)

1 visual alignment generator.
1 R.F. signal generator.
1 circuit tester.
1 junior scope.
1 set alignment tools.

Installation equipment (per crew)

6 rolls twinex
6 rolls co-axial cable.
6 antennas and mast
2 extension ladders
3 rolls guy rope
1 set small tools
1 kit miscellaneous brackets, straps, etc.

Field equipment (per technician)

1 circuit tester
1 junior scope
6 sets tubes
1 set service manuals.
4 kits component parts
1 kit small tools

Dealer and manufacturer alike must plan for television as an addition to, *not* as a replacement for sound radio.

When a television service commences operation in New Zealand there will undoubtedly be some adjustments necessary to our current conception of radio manufacture, sales, and service. Some of these will be of a temporary nature, others more permanent. We must accept overseas experiences which have proven that television does not supplant radio but supplements it.

Provision should therefore be made for the greater part of television plant, space, and personnel requirements to be *additional* to those now required for radio manufacture, servicing, and selling.

The industry, from factory to retailer, will fail in its obligations to the buying public if it is unable to provide efficient manufacturing and servicing facilities for both "sight and sound."

Television and the Serviceman

It is only natural to expect that since the television receiver is a very different animal from the conventional radio set, the technique of servicing it should also be different. This article gives some idea of these differences, and how they affect servicemen.

INTRODUCTION

There are several reasons why television servicing differs from its sound counterpart, and it is important that anyone who expects to be engaged in it should realize at least some of the things that are involved, and thus be prepared to cope with them.

In the first place, there is a great deal more detailed circuitry in a television receiver than in a broadcast set. Secondly, there are many functions in TV receivers that have no counterpart in the other, and finally, the adjustments that have to be made, even to a set in perfect condition, are much more critical than any that have to be made in sound receivers. This latter is not because TV sets are necessarily more "touchy" to adjust, or because they go out of adjustment more easily, but it is a function of the human eye, which is a far more discerning organ than the ear. As a result, the things upon which the eye is called upon to pronounce judgment must be correct to a considerable degree of accuracy. For example, geometrical distortion of the picture, due almost always to poorly designed or poorly adjusted deflection cicuits, is very easily seen, especially when the TV station is sending out its test pattern, and the viewer is able to take a ruler and actually measure the extent of geometrical distortion if he feels inclined!

As a result of all this, the work of the serviceman is much more exacting. In the early stages, it is likely to come into the category of a genuine headache, for not only will he be plagued by false alarms from viewers who are not able to set up the few simple controls that the set-maker provides them with, and other annoyances of a similar nature, but by complaints from viewers with, perhaps, one of the less expensive sets, who suddenly wake up to the fact that someone else's (costing twice the amount) gives a better picture for one reason or another, and thus demands that his set be adjusted to do likewise. In the early stages, it will be very difficult to convince people that what shows up as a defect, after the initial novelty value has worn off a little, can be remedied only by buying a better receiver!

By the same token, there will be precious little room for the serviceman who does not produce results. There will be no question of the customer's being satisfied with a set whose fault has been only partially cleared. For instance, with a radio set suffering from excessive hum, the customer will probably be quite pleased as long as a noticeable reduction results from the serviceman's ministrations, the latter having failed to find the real cause of the fault, but no amount of talking will convince him that his picture does not fold over at the top, or that it will stay in synchronism, for he has only to cast the most casual glance at the screen to see if these faults remain.

The inference to be gained from this is that TV servicing is a much more exacting business than that to which the radio serviceman is accustomed. Whereas "near enough" may be good enough for a five-valve broadcast set, it certainly will not be for a television receiver. What, then, will be the actual effect of this on those who expect to make some, if not all of their livelihood out of servicing them?

FUNDAMENTAL KNOWLEDGE

The first requirement will be that the would-be TV serviceman must have a solid grounding in television principles. This may seem self-evident, and even trite, but it is true for all that. While it is still true that experience will count for a great deal, and although there are bound to be some who are very successful without much knowledge of the theory behind what they are doing, these two things do not alter the fact that a sound theoretical knowledge is an essential part of the serviceman's equipment. The type of serviceman who can look at the picture for two seconds, and then dive straight into the innards of the set, right to the fault, is not likely to belong to the "inspired ignoramus" class. Rather will he be a man who has made it his business to learn not only how representative samples of TV circuitry work, but far more important than this, the very fundamentals of TV reception. This man would be confronted with say, an entirely new type of line scanning circuit, and would be able to make sense out of it because of his basic knowledge of what such circuits do and why, while the other, with no real knowledge of these things would be reduced to saying "I haven't met a circuit like this before" and giving it up as a bad job.

Now there will be very little excuse for any TV serviceman not to understand the fundamentals of his craft. There are many good books to be had on the subject, and an increasing volume of tuition becoming available. And by saying that the serviceman must understand the basic principles, we do not mean that he must attain the standard of theoretical knowledge required by an engineer responsible for designing TV sets. Nor do the good books referred to contain large quantities of mathematical reasoning that very few can be expected to understand. The principles of television, like those of most things, can be stated in non-mathematical terms, and in terms of physical explanations; but one must appreciate that television embodies more basic principles than do radio sets. In ordinary radio, one can often scrape by with only a very vague idea of alternating currents, because the valves which form the main framework of the circuit mostly work, and can be observed to do so, by virtue of the D.C. potentials placed on their various electrodes, and because of the direct currents which can easily be measured. This simple fact is the basis of the time-honoured volt-ohm-milliammeter method of receiver testing. But with a television set, a large and important part of it cannot be investigated at all in this way. In valves which produce peculiar waveforms such as pulses, distorted saw-tooth voltages, and the like, the presence of voltages on their electrodes, and the current drawn by them are very little indication of the proper working of the circuit. In much of the TV set, the

oscilloscope is the only true guide to a circuit's performance. The writer of this article has for some time been working on some quite complex TV equipment such as might be used in generating picture signals for broadcasting, and in several months' work he cannot once remember having used a voltmeter in an attempt to make a circuit work EXCEPT after having localized the fault to one particular valve. Even then, voltage tests will not always be of much assistance. For instance, they can hardly be expected to tell us much about why a flip-flop circuit is not triggering, when the cause is an open-circuited 25 $\mu\mu$f. condenser which should feed the triggering pulse into one of its grids. This brings us to our next topic.

TEST EQUIPMENT

The illustration above does not mean that ordinary fault-finding methods have no place in television servicing. They do have, because at least some of the circuits are exactly similar in principle, and not very different in practice from any other commercial receiver. What it does emphasize, however, is that quite a large portion of the TV receiver is not amenable to simple signal-generator and voltage tests. It is this part of the job that requires different equipment, of which the oscilloscope is the major item. The importance of this instrument cannot be over-estimated, for it is only by looking at the waveforms produced by a scanning or synchronizing circuit that one can tell whether it is functioning properly or not. But one look at the waveforms, coupled with the fundamental knowledge we have spoken of as the serviceman's most urgently needed tool, will often serve to identify the fault in a matter of minutes.

Contrary to what some people think, a special scope is not essential for TV work. All the waveforms are at either 50 cycles, when of frame frequency, or at 10125 c/sec., when of line frequency, and most of them are large enough in amplitude to make a scope amplifier unnecessary. A simple home-built instrument consisting of no more than the C.R. tube, its power supply, and a reasonably good time-base circuit, will be better for television use than a commercial instrument, unless the latter is in the high-priced class, and includes a really wide-band Y-axis amplifier. An ordinary scope, with a Y amplifier which goes up to only just above the audio range is almost useless, especially when no provision is made for direct application of waveforms to the Y-plates. Nor is a double-beam scope necessary. It is very helpful if you happen to be engaged in circuit development, but even then it can be done without. The trouble is that most TV waveforms contain very high-frequency components, so that if a Y amplifier is unable to handle these, the shape of the waveform is altered, and the investigator does not get a true picture of what is happening in the circuit. The frequency response of the plates themselves, however, is limited only by their stray capacities, which means that waveforms containing frequency components up to several megacycles per second can be displayed without significant distortion.

Apart from pulse waveforms, there is another very important job for the oscilloscope in TV servicing. It is in accurate alignment of the tuned circuits. In TV receivers, the old method of using an ordinary signal generator and an output meter is applicable only to that part of the set which corresponds exactly to a broadcast receiver, namely, the sound section. Everything else *must* be done by visual alignment. In other words, it is essential to have a signal generator which is repetitively swept over the pass band of the receiver. The same signal which varies the frequency of the oscillator is applied to the X plates of the scope, so that the pattern becomes a plot of the response of the receiver against frequency. This is necessary because of the great bandwidths used in TV receivers. The I.F. may be at, say, 15 mc/sec., and the response of the receiver may have to extend from about 14.5 mc/sec. to 18 mc/sec. Moreover, it is not sufficient for the receiver to respond over this wide range of frequencies. For a proper picture to be obtained, the response curve must have a particular shape, and the only sure way of aligning the circuits so that this response curve is in fact obtained is to use the aforesaid "wobbulator" method. This method can profitably be used in aligning broadcast receivers, but is not essential; but in TV work it is a "must." Thus, in addition to the oscilloscope, a frequency-modulated test oscillator is needed. This item should preferably have incorporated in it some means of identifying particular frequencies. For example, it is important to know that the video carrier frequency falls at the correct spot on the response curve. Also, various rejection circuits have to be aligned so that the sound signal that is transmitted along with the video signal does not interfere with the picture. All these things can be done very speedily with a wobbulator, but without one, they could only be done by an extremely laborious process of plotting response curves on paper. If this method were to be used conscientiously, aligning a TV set could take several days!

These are the main items of equipment. Another thing not likely to be found in an ordinary radio service shop is an electrostatic voltmeter for measur-

Tricity House Ltd., 209 Manchester Street, Christchurch, offers the experimenter New Zealand's most comprehensive stocks of Radio Components, plus the services of our efficient Mail Order Department. Our Workshops have already built and installed several television receivers.

ing the extra-high voltage (E.H.T.) that is applied to the anode of the picture tube. This voltage can be anything from about 4 kv. to 25 kv. and an electrostatic meter is the only kind that will give a true voltage reading in such cases. Rough means, such as using an ordinary multi-range voltmeter with a special voltage-dividing probe, can also be used, but are not always to be recommended.

Then for testing the performance of scanning circuits at times when the local station is not transmitting a test signal, a simple generator, which will produce a pattern of lines and bars on the viewing screen, is essential. This need not be an expensive item, but it is an essential one for any TV service shop to possess.

INSTALLATION

Apart from knowledge and equipment, the TV serviceman will find that he becomes involved in the installation of new receivers, and in setting them up in the customer's home. A TV set is not something which can easily be carted about under one arm, like the majority of modern radio sets. Even table models are too large and heavy for this, which means that many of the simpler servicing jobs will have to be done in the customer's home.

A TV serviceman will have to be able to advise on the choice of an aerial for each location, and to install it not only so that the receiver brings in a satisfactory picture, but so that it will not be blown down in the next storm, and so that the first time it rains, the picture will not deteriorate through faulty lead-in installation. He will have to know his own particular makes and models "inside out" so that if faults show up during installation, they can immediately be identified as belonging to the set itself, or due to such things as faulty lead-in cable or the reception of multiple signals by reflection. He will have to know exactly the directional characteristics of the range of aerials which his firm has available so that difficulties due to interference or to the site can be minimized. He will have to be able to explain to the customer how he can get the best results out of his set, once installed, and to advise him as to what undesirable effects, if any, he may obtain in his particular locality through no fault of the set or the installation. In the early stages, he will have to be prepared for service calls to re-adjust receivers that are not operating properly because the children (or the head of the house himself) have, in spite of instructions to the contrary, mal-adjusted the pre-set controls. In short, he will have to be a man of many parts, but television servicing is a field in which a great deal of satisfaction can be gained from the knowledge that one has done a skilled job well. And, seeing we all must live, there will be good profits to be made by the serviceman who really knows his job and does it well. For the servicing business, TV should be a real tonic, and a challenge, which with our oft publicized New Zealand versatility, we should be able to take in our stride, provided we realize before we start that we will all have much new knowledge to assimilate, and that it will not be the easiest job in the world.

Television—The American Scene

By a Philco Television Executive

Highly skilled inspectors load the chassis and picture tube on a final testing line known as the "heat rail." The television chassis rides for hours overhead, with current turned on, so that any defects in the electronic system may be caught before final assembly. This is the most exacting quality test given any television receiver prior to shipment to dealers throughout the U.S.A.

It is only since 1947 that television in America has been placed on a mass production basis. Since that time 23,600,000 sets valued at 8,565,000,000 dollars have been sold at an average unit figure of 362 dollars each.

Sound radio has been an established industry for thirty years and in that time 196,000,000 receivers have been distributed for 10,132,000,000 dollars, or an average of 52 dollars per set.

In six years TV has accomplished 86 per cent. of the business it took radio thirty years to achieve. With only one-third of sales saturation reached, television is, today, one of America's major industries.

Set prices in the United States have remained relatively stable during recent years. A realistic appraisal of the future costs of television receivers indicates that the average unit price will remain high. The belief that television costs will follow the same pattern as radio and fall spectacularly is hardly justified when it is recalled that radio prices dropped in such a manner only when the manufacture of sets and components came "off the bench" and into mass production. Television started in mass production and only exceptional technological developments will alter costs to any marked degree. With the advent of colour TV, there is reason to believe that unit costs will be even higher.

American television stations are privately owned, with revenue being secured from advertisers who evalue the worth of their outlay by the number of viewers reached. TV has inherent qualities that enable it to reach a great mass of consumers in an effective and interesting manner. It can employ the visual impact of newspapers and magazines, the oral persuasion and personal intimacy of radio and, in addition, by combining sight and sound with motion, makes product demonstration possible.

The effectiveness of advertising through TV has considerably reduced the amount of business done by "sound only" commercials. It is significant to note that while the value of network television advertising rose from 12,300,000 dollars in 1949 to 180,800,000 dollars in 1952, network "sound" advertising dropped in the same period from 190,000,000 dollars to 160,000,000 dollars. The proportionate loss in "sound" is greater when it is considered that the aggregate value of national advertising handled by magazines, newspapers, TV, and sound networks, showed an overall increase of 4 per cent. during those four years.

Advertising charges are based on the number of sets operating within the station's area. In 1949 the full C.B.S. network price per 1,000 receivers was 4.75 dollars for an average half hour's evening programme—this year it is 2.38 dollars. The declining trend can be attributed to the increasing saturation of existing television markets and to the greater coverage stations are now attaining.

Many sales success stories have been attributed to television advertising. A typical example is that of John G. Paton Co. Inc., manufacturers of "Golden Blossom" honey. The advertising campaign for this company was exclusive to TV. A one minute commercial was used five times weekly and took the form of an animated cartoon showing a buzzing bee. Added to this were demonstrations showing several table uses for this particular product. The net result of the campaign was that the year's supply of honey was sold before half the telecast contract expired!

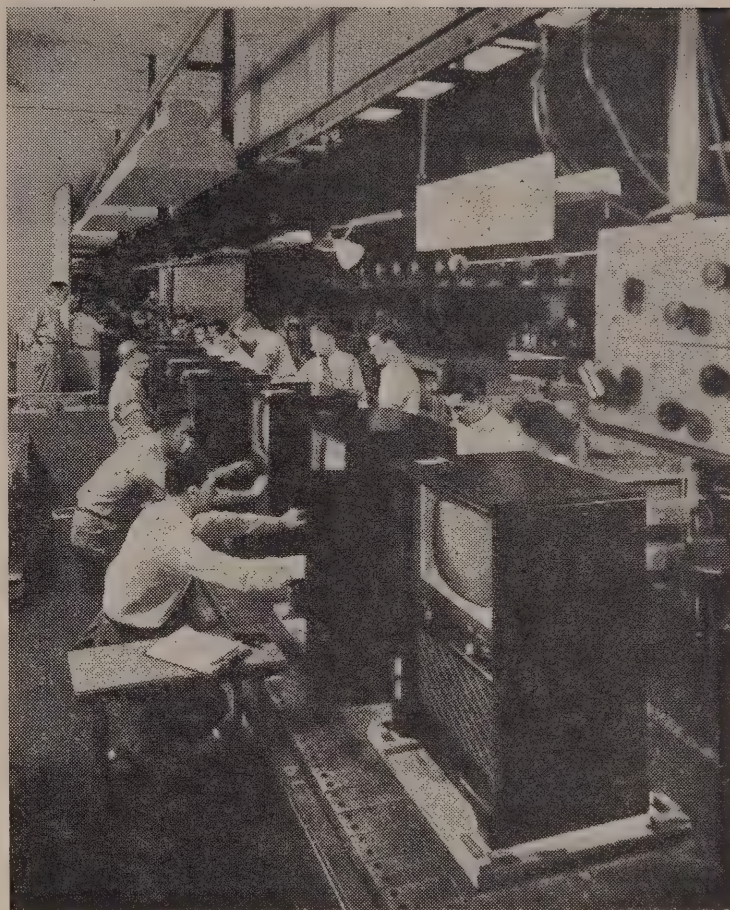
The United States Census Bureau assessed American television markets as at the 31st January, 1953. Areas were classed on a population basis and major markets were:—

Market Classification	Population	No. of Markets
"A"	2,000,000 and over	8
"B"	450,000–2,000,000	35
"C"	150,000– 450,000	72
"D"	50,000– 150,000	47

Some critics in New Zealand have repeatedly stated that a television service could not be economically operated in this country. American commercial stations all operate as private companies, each charged with making a satisfactory profit for its shareholders. There are in the United States many areas where conditions of terrain and population density, etc., are very similar to those which exist in and around our own major cities.

In Colorado Springs, Station KKTV operates in a city of 45,472, there being 164,771 people within a twenty-five-mile radius. James D. Russell, President and General Manager, states: "KKTV is now operating satisfactorily, being out of the red after twelve months' service." Television was introduced to Colorado a year ago and 20,000 sets have so far been sold within the range of the new station.

Lubbock, Texas, is another market comparable with some of our own. Within the area of Station KDUB-TV there is a total population of 317,700 of which 67,200 is metropolitan and 250,000 urban. The city itself is a dry area and operates twenty-four movie theatres and two night clubs. KDUB-TV employs a staff of twenty-nine, nine of whom are attached to the Sales Division. The station is on the air sixty hours weekly



These television receivers are just about ready for shipment to dealers throughout the U.S.A. But, one final inspection is given each set to make sure the receiver will be in perfect working order when it reaches the purchaser. Inspectors are turning knobs and checking the inside antenna to make sure the sets match quality standards.

and 80 per cent. of revenue is derived from local advertisers. President W. D. Rogers recently stated that television's greatest impact is being made in the smaller markets of 100,000 people and less.

For comparison purposes, it is of interest to note the population of major New Zealand urban areas estimated by the Government Statistician as at 1st April, 1952. These are:—

Auckland	337,100
Hutt	77,300
Wellington	135,300
Christchurch	178,500
Dunedin	96,400

Overseas experience has proved that the majority of earlier "fringe area" difficulties have been overcome. Low cost microwave relays to towns outside a station's normal range have also proved to be the most economical means of increasing viewing capacity.

Television in New Zealand will benefit considerably from the great wealth of experience and knowledge available from countries in which TV has already been successfully established.

The economic and technical information available from America is considerable and will exercise a major influence on New Zealand's television future.

Here the Philco television chassis and picture tubes pass down the mono-rail "heat line" where inspectors check and recheck the performances of each unit. Both chassis and picture tube ride for hours with the current turned on to make sure no defects appear later.

. . . . Philco's Contribution to Television Progress

Television's greatest progress since the war has been in the development of improved receiver design and the fantastically increased efficiency of mass-production techniques, with the resultant ability to reduce prices. In this sphere, Philco has been the real leader. A brief resume of Philco's achievements in commercial Television goes back over 25 years. The cost of T.V. development and research has exceeded 20,000,000 dollars since Philco entered Television in 1927. The problem at that time was simply to find a method of picking up a picture, transmitting it by radio to another location, and reproducing it there. It was soon discovered that the only feasible method of accomplishing this was by electronic means, and, in 1934, Philco was the first to transmit and receive 343-line Television pictures. Philco was the first in America to broadcast Television by electronic means.

In 1935, Philco was the first to utilize DC components for greater picture fidelity, or, in other words, to reproduce, again by electronic means, a picture with the same degree of contrasting lights and shadows as the original picture contained.

In 1936, only two years after perfecting 343-line Television transmission, Philco was able to materially increase picture fidelity by transmitting a 441-line picture. In this same year, Philco developed the single side-band transmission, after discovering that this was nearly 60% more efficient than the old double side-band method. In addition to eliminating wasteful use of frequency band, the single side-band method also provides superiority of picture detail.

In 1938, Philco was the first to develop a flat-screen Television picture tube for home receivers (Philco Plane-O-Scope).

It was apparent in later years that the 441-line picture developed by the Company in 1936 left something to be desired. Following considerable research, Philco released in 1940 a 525-line picture which was adopted by the Federal Communications Commission in 1941, and is still standard in the American industry. Just about the same time, Philco was first to use FM sound with Television programmes. This, too, was adopted by FCC in 1941. In 1941, Philco's own station, WPTZ, was granted the first commercial licence in Philadelphia, and was the second to be so licensed in the United States. Up to this time, Philco had been operating under an experimental licence W3XE. In the same year Philco constructed and put into operation the first radio relay for Television between New York and Philadelphia. In 1945, Philco built the first radio relay system for Television connecting Washington and Philadelphia.

In 1948, Philco was the first to introduce the expanded screen, adding 50% to the viewing surface. In 1949, Philco introduced the electronic built-in aerial, which out-performed all others by as much as 3 to 1.

In 1950, Philco announced the TRANSIENT Analyser—a revolutionary instrument for testing T.V. receivers.

The year 1951 brought another outstanding Philco development—the Cylindrical face tube. This tube, optically engineered to eliminate glare, was the years' most advanced feature.

Last year Philco introduced the Golden Grid Tuner. Comparable to a boost in station power, the Golden Grid Tuner brought a clear, steady picture to vast new areas for the first time.

IN 1952, PHILCO SALES OF TELEVISION RECEIVERS IN AMERICA EXCEEDED BY FAR THE COMBINED OUTPUT OF ALL BRITISH MANUFACTURERS. Philco Television Receivers, developed for every type of system operating, are now manufactured or distributed in all countries in which television has been established. Philco's manufacturing units plan to produce more than half a billion dollars' worth of merchandise in 1953.

Philco will manufacture over one million television sets this year. The range of thirty-six models was previewed in an American coast-to-coast closed-circuit Television show held last February. Dealer meetings were organized simultaneously in fifty cities, each seeing on the screens the main broadcast from Philco Headquarters. Philco this year brings to T.V. two further major advances—the only directional UHF-VHF built-in aerial and an all-channel U.H.F. tuner which enables every station on the air in any community to be received. Philco established and is maintaining the world-famous slogan, "PHILCO—the Leader."

Philco—The World's Largest Radio and Television Manufacturers

New Zealand Licensees

The Dominion Radio & Electrical Corporation, Ltd., Broadway, Auckland.

Preparation for Television

(Continued from Page 19.)

or more are recommended, however, and the tubes cost about 70 dollars, so such a project cannot be undertaken on a very small budget.

Even when the TV experimenter has decided what type of picture source he will use, he still has a wide choice before him. If his project is to be a relatively simple one he will most likely commence with a non-interlaced picture, as no elaborate synchronizing generator is required. A simple stable oscillator of line frequency to provide line synchronizing pulses and a low frequency source, preferably locked to the A.C. mains frequency, are all that are required. There will be imperfections due to line drift and so on, but a fairly good picture can be obtained with minimum expense, and the complete synchronizing generator, such as has been described in recent issues of this magazine can be added later. It will, of course be essential if we wish to test actual receivers effectively or to put a satisfactory signal on the air, but the earlier stages of a project are usually concerned with operating over a wired circuit.

Even a wire system can be very elaborate, as those who saw the demonstrations at 1YA and 2YA in 1951 will appreciate, but a TV signal may be put on the air with much less equipment than this, as has been done at Canterbury College and, we understand, is planned by certain other organizations.

An an example of a simpler system was the equipment built by Radio (1936) Ltd. almost two years ago for experimental and demonstration purposes. In its earliest form, as seen in the illustration, the system was operating at 300 lines, not interlaced, with 50 frames per second. The picture source was a monoscope tube, of British manufacture, operating at 1200 volts H.T. derived from a specially developed, earthed positive, stabilized power supply. Five stages of video amplification, excluding cathode followers, were used, and the picture was reproduced on a 14 inch rectangular picture tube with 8000 volts E.H.T., derived from the line flyback.

From all points of view, the prospect of TV in New Zealand is stimulating. New fields are opening for technician and tradesman, and the experimental possibilities are unlimited.

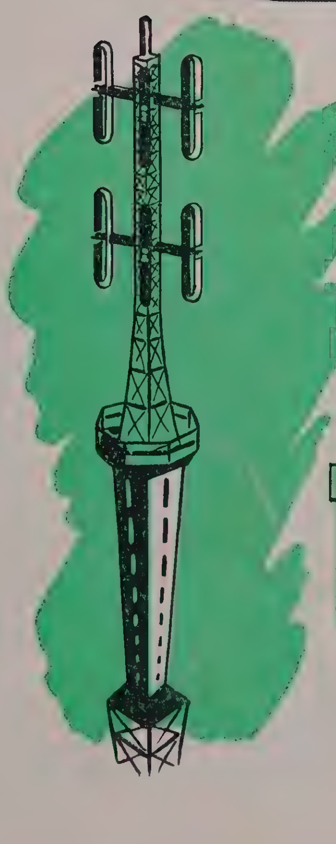
GREAT PYE ACHIEVEMENTS

(Continued from Page 7.)

immediate direct contact to London or elsewhere. Pye P.T.C. 704 equipment was used for this installation. The four flagships of the Home, Mediterranean, and Reserve Fleets and of the Submarine Service were also equipped with Pye radio-telephone apparatus. The ships were: H.M.S. *Vanguard* (Home Fleet); H.M.S. *Glasgow* (Mediterranean Fleet); H.M.S. *Dido* (Reserve Fleet); and H.M.S. *Maidstone* (Submarine Service). The B.B.C. Television Service gave a programme from Spithead, and here again the Pye team of television engineers rendered valuable assistance, by providing the special link equipment to transmit a picture from a ship at sea to the shore. Pye television cameras were also used by the B.B.C. during the course of this transmission.

On the very roof of the world Pye equipment was used by Colonel Sir John Hunt's successful Everest team. The Pye Company was proud to have been able to supply the radio communications equipment on which the Mt. Everest team relied throughout their brilliantly successful expedition.—P.B.A.

FIRST N.Z. MADE TELEVISION RECEIVER DEMONSTRATED BY ULTIMATE IN 1952



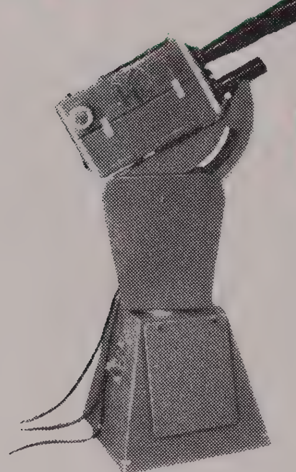
The Ultimate equipment illustrated above was designed and built in 1952 by Radio (1936) Limited for demonstration in New Zealand. It reproduces a picture from a British monoscope "camera" tube. The number of lines can be varied, and as demonstrated was set at 300, not interlaced, with 50 frames per second. The picture is reproduced on a 14 inch rectangular "picture" tube. Radio (1936) Limited have thus demonstrated their ability to keep pace with overseas developments and when television comes to this country will be able to offer TV receivers that will be second to none. The proud name of Ultimate will be carried forward into this new sphere, giving the same beauty, quality and matchless performance in television that is found today in all Ultimate Radio receivers.

ULTIMATE

RADIO (1936) LTD.

6-14 QUAY STREET - - AUCKLAND

PRODUCING A TV PLAY



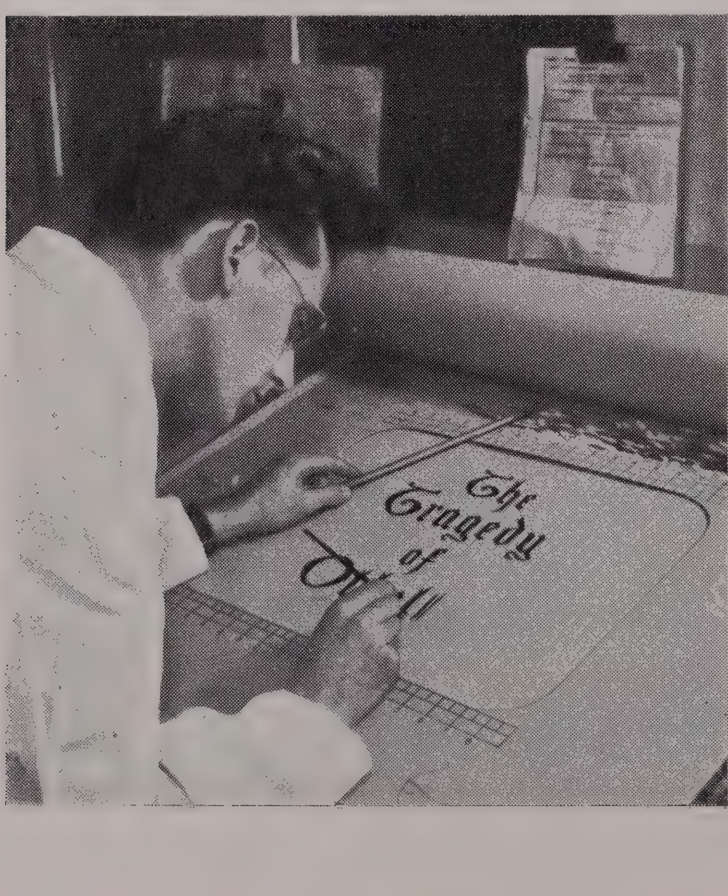
By the end of 1953, the B.B.C. Television Service will have transmitted over 150 plays—an average of three a week, not counting Saturday-night serials and repeat performances. The output of the Drama Department has greatly increased during the last few months and plays are very high on the list of viewers' favourite programmes.

The average full-length play transmitted by the B.B.C. runs for about 100 minutes and takes three weeks to prepare and produce. It starts as an idea. The Head of the Drama Department may decide that a certain play should be televised, or individual producers may suggest plays which they would like to do. The majority of subjects used are established theatre plays, though frequently television provides a platform for little-known works or plays which are difficult to present in theatres.

An example of this was George Bernard Shaw's "Back to Methuselah," only once produced in London's West End. The B.B.C. presented it on television as a Saturday-night serial for several weeks and made a most successful job of it.

More and more plays are being specially written for television, with the result that production is smoother and the impact on viewers usually greater. Plays which were originally written for the theatre have to be adapted for TV and the transition from stage to screen must be carefully arranged. A situation which, played on a large stage in a crowded theatre, requires arm-waving and a declamatory voice, is quite unsuitable for the intimate relationship of the television actor and his fireside audience of three or four. Too-rapid movements must be avoided and action must flow evenly.

TV offers advantages to the dramatist far greater than any other medium. There is practically no restriction on



Left: Artist draws a title—the first thing to come before the camera.

Below: Producer and his assistant work out details with the aid of a model of the proposed set.

what can be "put over" to the viewer. The resources of the theatre, radio, and films are at the disposal of the TV producer. If, for instance, a scene in a play calls for characters to be suddenly transported to some outdoor setting, the producer confined to a theatre has to make do with a change of actual scenery or off-stage effects. The television man, however, merely takes his actors to a convenient outdoor spot, films them in action, and then, at the appropriate moment during transmission, inserts his bit of film into the programme. The "matching" of film inserts to the "live" part of a TV programme has now reached such a pitch of efficiency that the majority of viewers are often quite unaware that film has, in fact, been used at all.

Having chosen his play, the television producer next chooses his cast and rehearsals begin—but not in a TV studio. For about two and a half weeks the play will take shape in a bare rehearsal room, with no scenery, few "props" and no cameras or technical equipment.

Chalk marks on the floor will indicate the positions of scenery, and the producer hops around in front of his cast, "standing-in" for the cameras. He holds to his eye a small device which "frames" the action in the same way as camera lenses will later on.

Rehearsals continue and the cast become word-perfect and—most important—movement perfect. Whereas in a theatre overstepping a few feet or moving slightly in the wrong direction has little effect on the audience, a wrong movement of only a few inches could take a TV actor out of a close-up shot.

Besides rehearsing his cast, the producer has many other things to do. On a scale-size blueprint of the studio floor he plots his sets, every single movement of the cameras, the exact positions of tables, chairs, and other properties.

Meantime the designer attached to the programme has made drawings of the scenery he requires, and this is put in hand by the carpenters and painters.

Two days before transmission—that is the day of transmission and the day before—the cast assembles in the studio for the first time. They do a rough run-through of the play to familiarize the cameramen and studio staff with the action, then "stop-and-start" rehearsals begin. Any scene-changes are rehearsed and timed by rubber-shoed attendants, engineers train batteries of lights on to the cast and arrange special effects where required.

The man with one of the most difficult jobs is the sound engineer. He has to ensure that viewers will hear clearly every word that is spoken and any music or sound effects that may be used. But he must not allow his microphones to appear in vision. Most of the dialogue is carried by microphones slung on movable booms above the actors' heads, but frequently it is necessary to hide other microphones in flower-vases and otherwise disguise them.

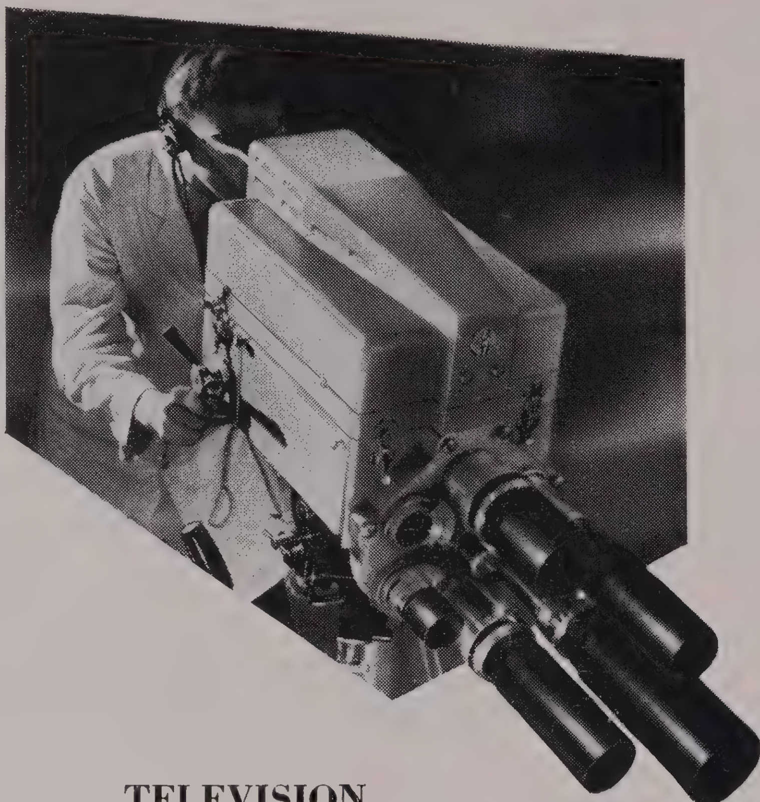
About two hours before the play is transmitted to the public the producer finishes a final run-through, using the TV cameras on a closed-circuit which confines the pictures to the studio control room. Then, at the advertised time, lights flash, "Sound On, Vision On," the play begins and engineers send the picture from the studio up to the main transmitter and so out to Britain's television network.

For 100 minutes the artists give of their best and viewers approve or disapprove. Then it is over and the play—the result of nearly a month's hard work—is gone, vanished into the air. For a repeat performance they must go through it all again.

In the not-too-distant future overseas television stations will be able to show the B.B.C.'s plays, which are acknowledged to be the best of their kind. Technical equipment is already in use whereby a film record can be made direct from a television screen. These "telefilms" as they are called in Britain (in America the term is "kinescopes") can be sent to any other television station and retransmitted.

Properties, batteries of lights, cameras, microphones, and production technicians, and last but not least, the artists themselves, are all "on" during a scene in a TV play.

E·M·I



TELEVISION

The latest C.P.S. Emitron Camera with 6-lens turret—an entirely new conception in television which completely satisfies the exacting requirements of both producer and operator.

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Complete television transmitting stations, including film channels, Emitron cameras, sound equipment, aerials, transportable and mobile transmitters • Television Receivers • Radio Transmitters • Broadcast and communications receivers (A.M. and F.M.) etc. • Radio and television relay equipment velocity modulated oscillators • Multiplier phototubes.

Electrical and Musical Industries Ltd., Headquarters, Hayes, Middlesex, England

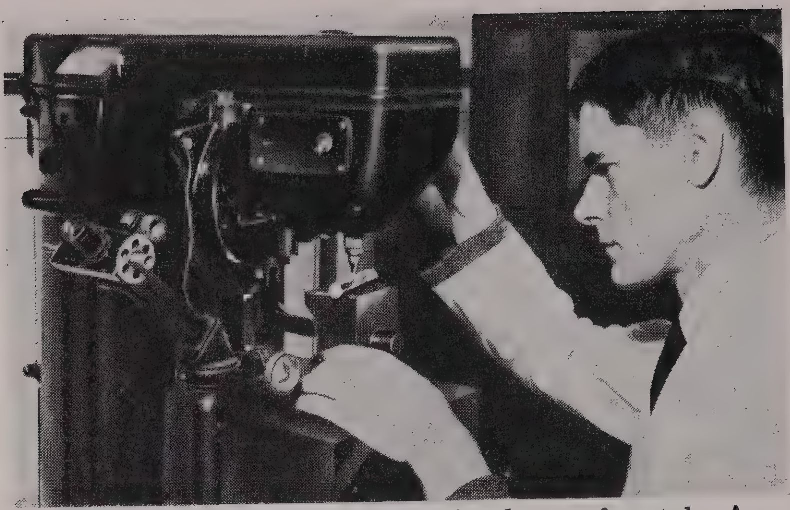
E.M.I. SUPPLIERS

(Trade Division of H.M.V. (N.Z.) Ltd.)

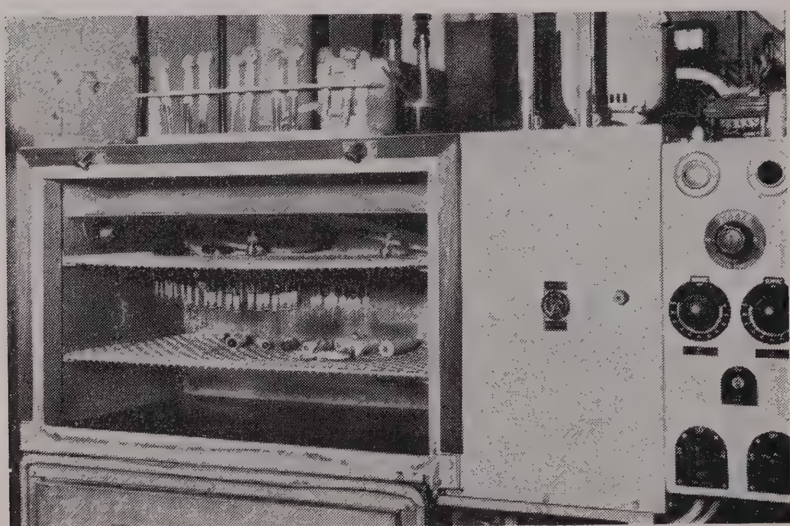
162-172 Wakefield Street Wellington. P.O. Box 296. Phone 54-890

PHILIPS

receivers undergo severe tests at every stage of manufacture for quality control . . .

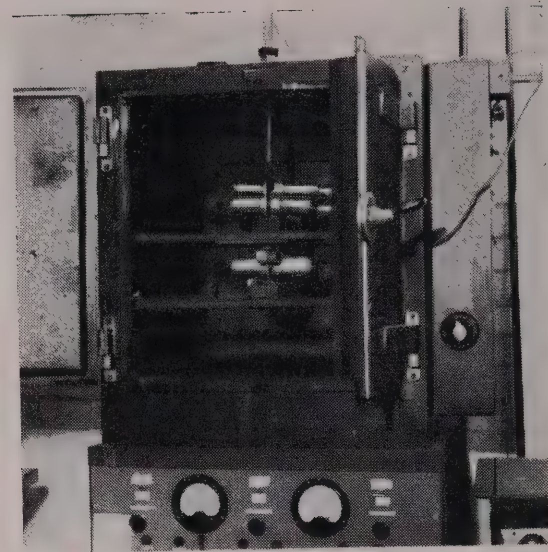


1 This machine tests the hardness of metals. A sharp diamond pyramid, with a measured pressure load behind it, indents the surface of the metal under test, and the depth of the indentation is precisely measured under a microscope. Tables give the hardness of the metal.

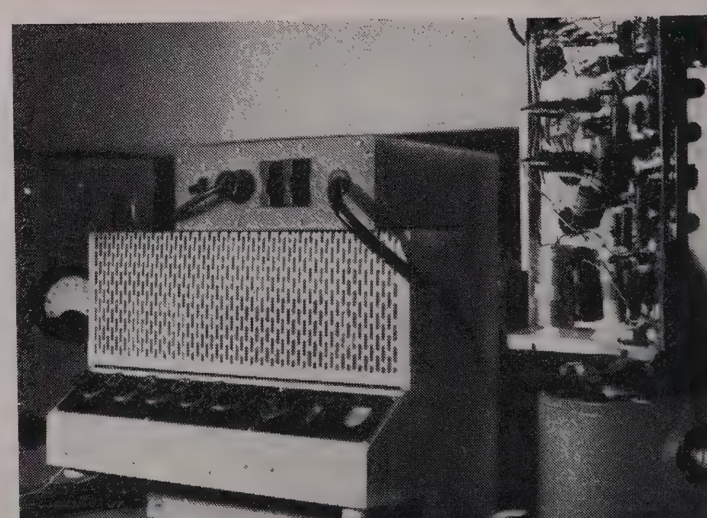


2 This tropical chamber in which components are tested can produce dry temperatures up to 100° Centigrade and humid conditions at 55° C. with 100% humidity. The row of cultures in test tubes above it are a standard set of moulds for testing all kinds of organic materials.

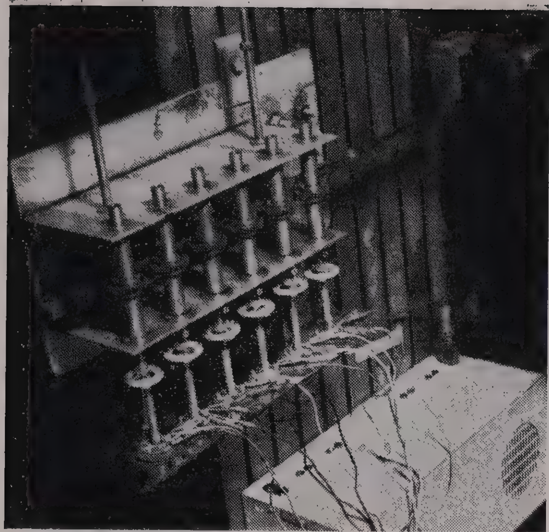
3 A glass-topped artificial sea-spray tank in which artificial sea-water is atomized, forming a heavy fog. After six hours in this, components are left for twenty-four hours to give the salt water time to affect them.



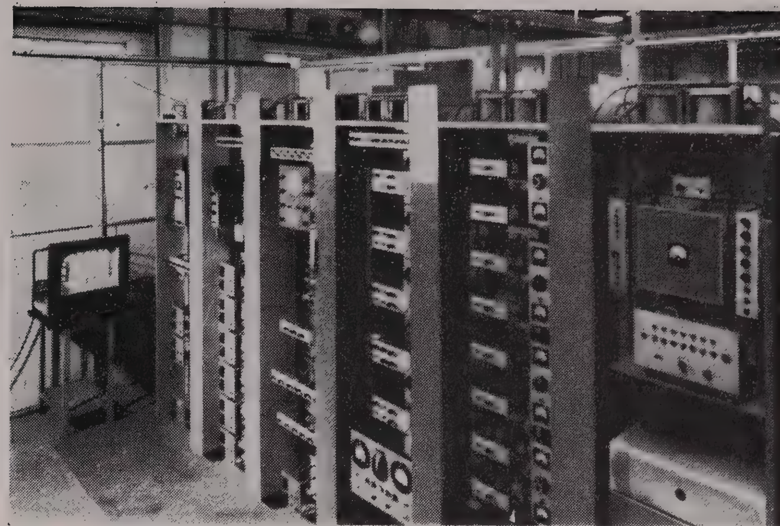
1 Here are some electrolytic condensers undergoing a 2,000-hours' endurance test at a temperature of 70° C. under maximum rated working conditions, including A.C. ripple, from the power pack below. The oven is thermo-controlled by the mercury column seen in the top.



5 A chassis on vibration test. A vibrating coil assembly, used with a B.F.O. and amplifier, produces vibrations of 5-500 cycles per second. By variations over this range, every component, wire, and joint is made to vibrate at its natural frequency.



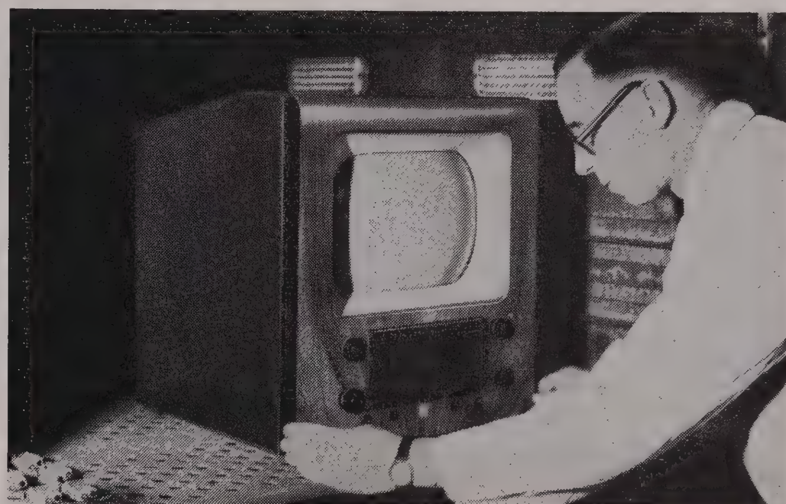
6 In their mechanical endurance test, these six switches are being switched on and off 25,000 times. The machine can operate twelve switches together, and is fitted with a mechanical counter.



8 Built by Philips five years ago, this low-power TV transmitter gives an electronically produced test pattern on five channels. It provides all variations and combinations of contrast, definition, and linearity which could be met in a broadcast picture. It is set to the minimum synchronization level to ensure maximum performance.

TV

tests such as these ensure the dependability which has contributed to Philips leadership in television equipment

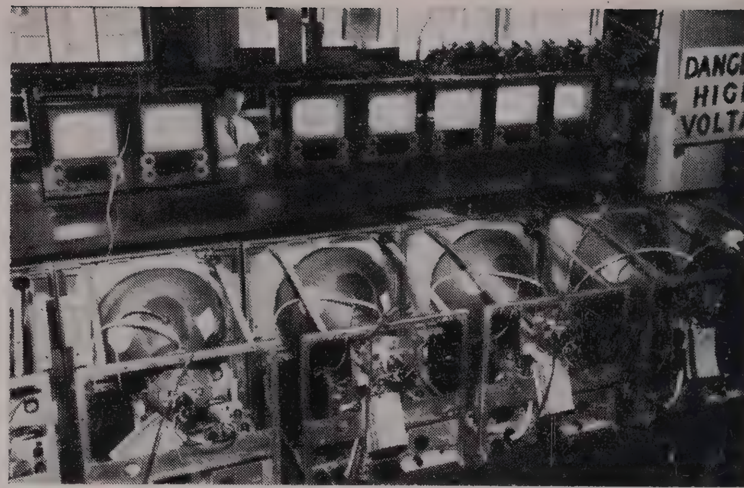


9 A completed receiver goes into the tropical atmosphere test chamber, where it will be subjected to a temperature of 42° C. with 95% humidity. It will then be cooled down. The complete cycle lasts 24 hours, and will be repeated for six days.

7 In an underground basement, banks of loudspeakers are run for 200 hours on their maximum rated input at a frequency of 50 cycles.

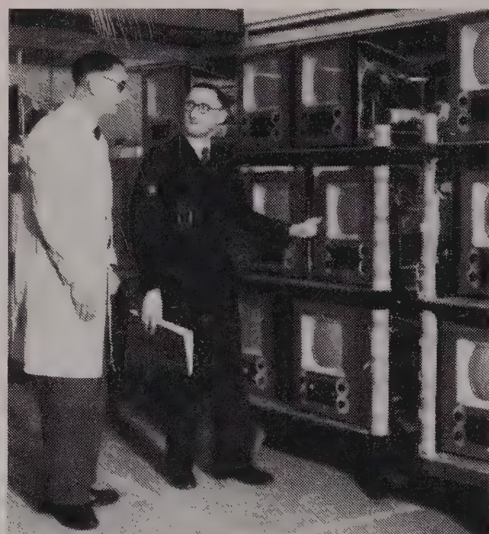
10 In the refrigeration chamber this receiver will have to withstand 45 degrees of frost for six hours. Similar chambers are used for component tests, and go down to temperatures even lower.

11 At any stage of production any receiver is liable to be taken from the assembly lines and thoroughly tested in the laboratory.



12 These banks of receivers are undergoing their running-in test on overload. A proportion of them will be given 1,000 hours of this treatment.

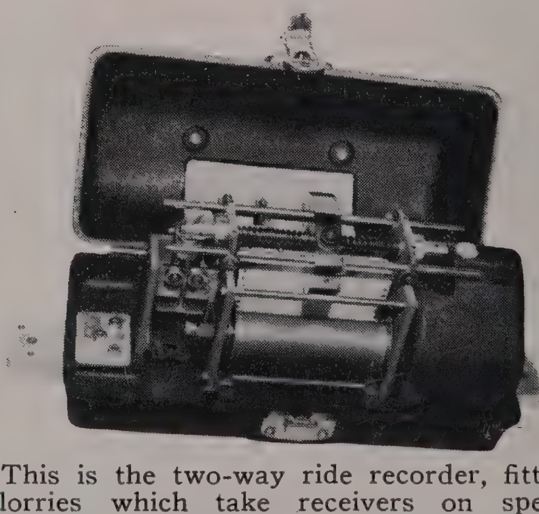
13 Final mechanical inspection is made after all the other tests have been passed. This is a most exacting inspection, and no deviation from standard is tolerated.



14 Representing "customer interest," a technical specialist from the Commercial Department selects at random a finished receiver which he will have rigorously tested in whatever way he chooses. When he is satisfied, the batch may leave the factory.

15 On this violently oscillating platform, simulating travel on rough roads, receivers in their packing are given a thorough shaking for ten minutes. They are then inspected for any damage or displacement of components. The packing is also inspected.

16 After a "drop" test, a final challenge to the construction of TV receivers and the strength of their packing is provided by this ramp. The carton is placed on a bogie and set off down the ramp to collide violently with the bulwark at the end. Inspection follows.



PHILIPS

17 This is the two-way ride recorder, fitted to lorries which take receivers on specially rough journeys. "Vertical" and "Horizontal" styli record on graph paper the "bumps" met in the road so that the roughness of the whole journey may be studied afterwards.

Philips Electrical Industries of N.Z. Ltd. Factories in Wellington. Branches: Wellington, Auckland, Christchurch, and Dunedin.

Philips Experimenter

(Continued from page 24.)

(4) **I.F. Amplifier** in any of the circuits mentioned in (1) above, for low-noise operation.

(5) Special pulse circuits, such as multivibrators, flip-flops, etc.

EF80:
(1) **R.F. Amplifier.**
(2) I.F. Amplifier.
(3) Mixer or Oscillator-mixer.
(4) Video Amplifier.

EB91:
(1) Signal Detection.
(2) D.C. Restoration.
(3) Noise Limiting.

PL83:
(1) Video Output Pentode, particularly for projection television.

PL82:
(1) Sound Output Pentode.
(2) Frame Output Pentode.

PL81:
(1) Line Output Pentode.
(2) E.H.T. pulse amplifier (in E.H.T. systems not connected with line output stage).

ECL80:
(1) Frame Blocking Oscillator (triode) and frame output (pentode section).

(2) Line Blocking Oscillator (triode) and frame output (pentode).

(3) Audio Voltage Amp. (triode) and sound output (pentode).

(4) Frame or Line Blocking Oscillator (triode) and Synch. Separator.

(5) Half of Frame Multivibrator (triode) and frame output (pentode).

(6) Line Multivibrator or Frame Multivibrator..

PY80:
(1) Booster diode.

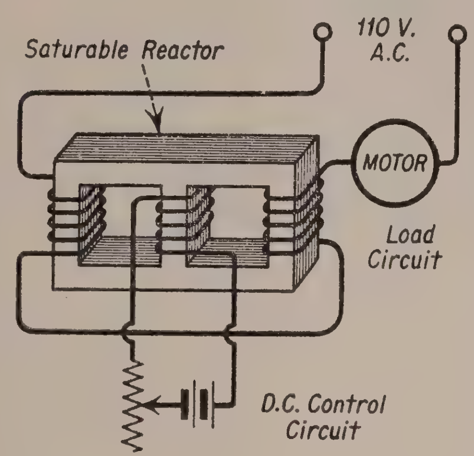
EY51:
(1) E.H.T. Rectifier.

(Continued on page 48.)

The Magnetic Amplifier

By the Engineering Department, Aerovox Corporation

The magnetic amplifier, like the transistor and the dielectric amplifier, is an electronic device which is currently undergoing extensive exploitation as a vacuum tube substitute. Like these promising contemporaries, it has advantages in certain applications which make its use preferable to the electron tube. This article discusses these advantages and the operating principles which make them possible.



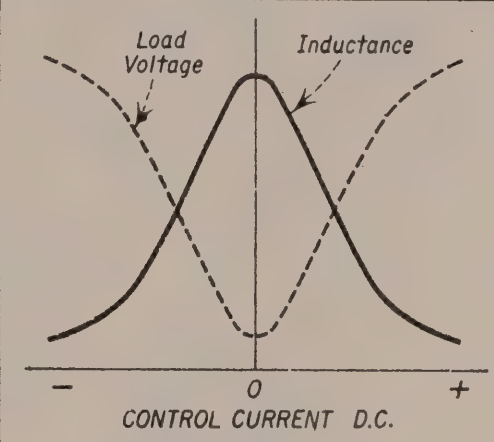
ELEMENTARY MAGNETIC AMPLIFIER
FIG. 1

The major field of application for the magnetic amplifier at the present time is in industrial control circuitry such as A.C. and D.C. motor speed control, servo systems, voltage and current regulators, temperature controls, and industrial safety circuits. The sphere of usefulness is rapidly being expanded, however, to include audio and radio frequency amplification for communication purposes extending up to several megacycles. These advantages are being made possible largely because of improvements in the ferromagnetic materials employed in the saturable reactors. These include the grain-oriented silicon steels and gapless toroidal cores. Strides are also being made in improved circuits and better selenium and germanium rectifiers for use in amplifier circuits.

The magnetic amplifier is useful because of its high power handling capabilities, low cost (intermediate between that of tube and dielectric amplifiers), and extreme ruggedness. It is being applied to power amplifications ranging from a few watts to thousands of kilowatts. Its economy and reliability are certain to assure it a permanent place in electronics.

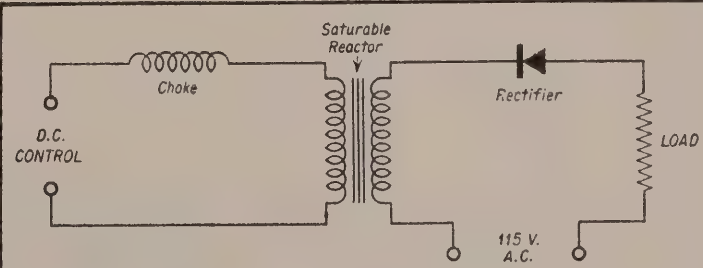
THEORY OF OPERATION

The magnetic amplifier completes the family of electronic devices which function because a control voltage causes a variation in one of the basic electrical properties of a circuit component. The vacuum tube amplifier, for example, may be thought of as a device in which a change in the control voltage on the grid causes the cathode-plate *resistance* to vary. In the dielectric amplifier a change in a control voltage effects a change in the *capacitance* of a condenser and therefore its reactance. In the magnetic amplifier, the variation of a control voltage brings about a change in the *inductance* of a coil and, hence, its inductive reactance. In all three cases, the control power required to effect the change is less than the power controlled, so that the devices are classed as amplifiers.



RESPONSE OF SIMPLE SATURABLE REACTOR
FIG. 2

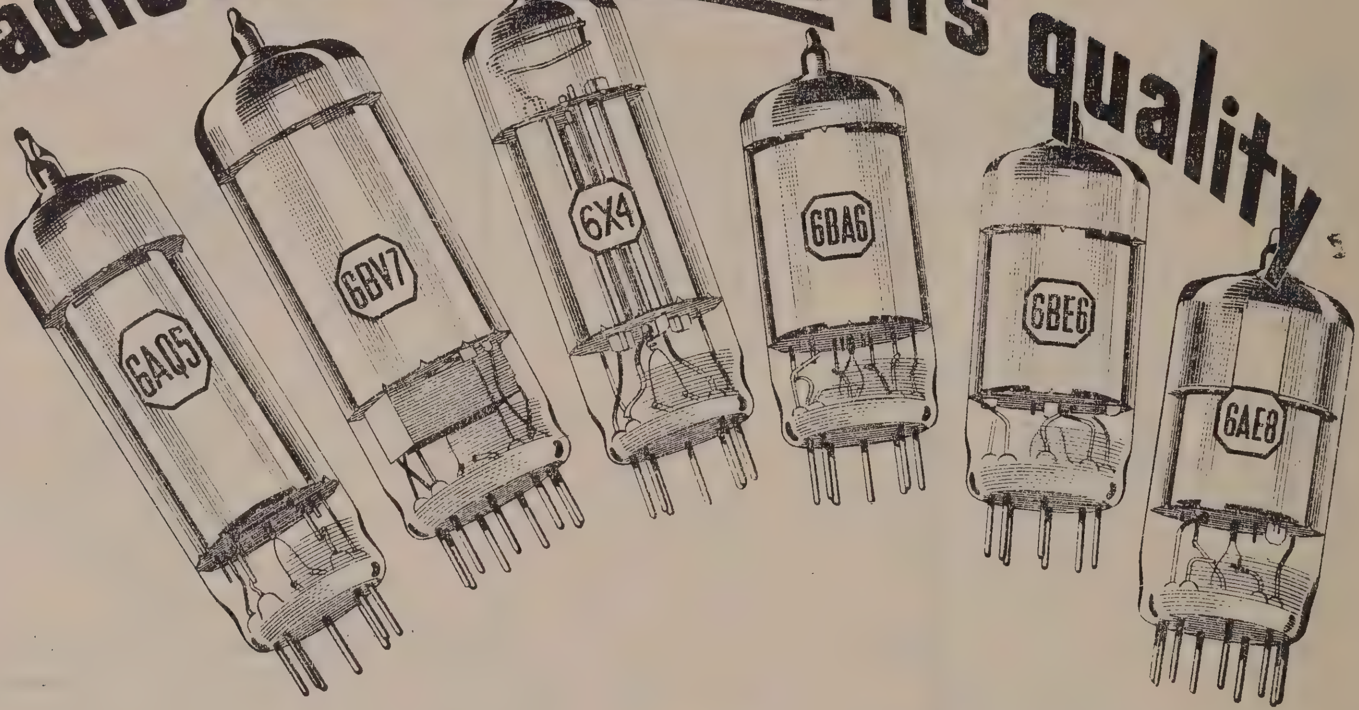
The saturable reactor, which is the basis of magnetic amplification, functions because of the *ferromagnetic* properties of the core materials utilized. A simple saturable reactor which will illustrate this principle is shown in Fig. 1. Three windings are arranged on an "E"-type transformer core and connected as shown. The alternating current to be controlled flows in the windings on the outer legs and the D.C. control current flows in the centre-leg winding. Note that this arrangement prevents the induction of alternating current from the load circuit into the control circuit because the flux produced by the outer coils cancels in the centre leg. The control winding, on the other hand, can produce saturation of the core material when energized with D.C., and thus greatly effect the permeability of the core material. The inductance of the A.C. coils are directly proportional to the permeability of the core, and the inductive reactance is directly proportional to the inductance. The way in which the load circuit inductance varies with D.C. control current is shown qualitatively in Fig. 2. The reactance, and hence the voltage drop across the coils, is maximum when the control current is zero and minimum when the core is saturated. Thus, the power applied to the load is a function of the D.C. control current.



SELF-SATURATING MAGNETIC AMPLIFIER
FIG. 3

Simple magnetic amplifiers of the type illustrated in Fig. 1 are not capable of high gain performance. They have been almost completely superseded by improved magnetic amplifiers of the *self-saturating* variety. The

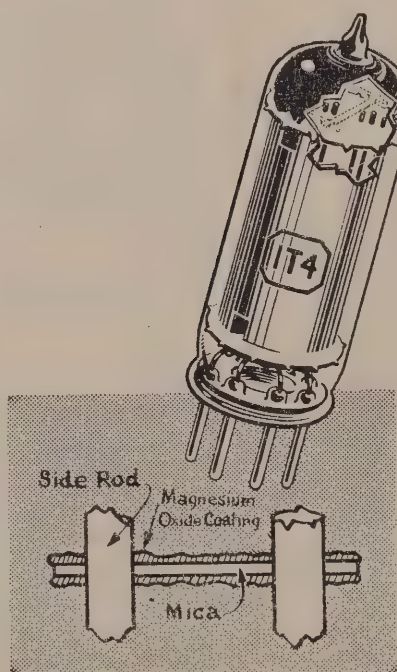
Radiotron in-builds its quality



Improvement of the natural properties of some of the materials used in the manufacture of Radiotron valves is merely a routine process at the Ashfield Works of Amalgamated Wireless Valve Company Pty. Ltd.

A case in point is the mineral mica. It is, inherently, an excellent insulator, and is widely used by the electrical industry in this role.

However, before it can be used as a component part of a high-quality Radiotron, its insulation resistance has to be considerably increased.



From the accompanying illustration, it will be seen that the internal assembly of a typical Radiotron is supported at the top and bottom by spacers.

When it is realized that parts held by the spacers are perhaps only 30 thousandths of an inch apart and possibly differing in potential by several hundred volts, it becomes apparent that the spacer material must have exceptional insulating properties.

Mica is made to fulfil this condition by coating with a special spray of magnesium oxide.

This spray must adhere firmly to the mica during assembly, washing in an alcohol-water mixture, and firing at 650 deg. C. in hydrogen.

Also, the required insulation must be produced without an unnecessarily heavy coat.

The secret of obtaining all these properties in one spray lies in the degree of hydration resulting when the magnesium oxide is ground in distilled water for a period of several days.

Manufactured by the A.W.V. Chemical Laboratory, under close quality control conditions, this spray is a vital contribution to the outstanding performance of reliable RADIOTRON VALVES.

AWV

RADIOTRON

VALVES

New Zealand Distributors:

THE NATIONAL NEECO ELECTRICAL AND ENGINEERING COMPANY LIMITED

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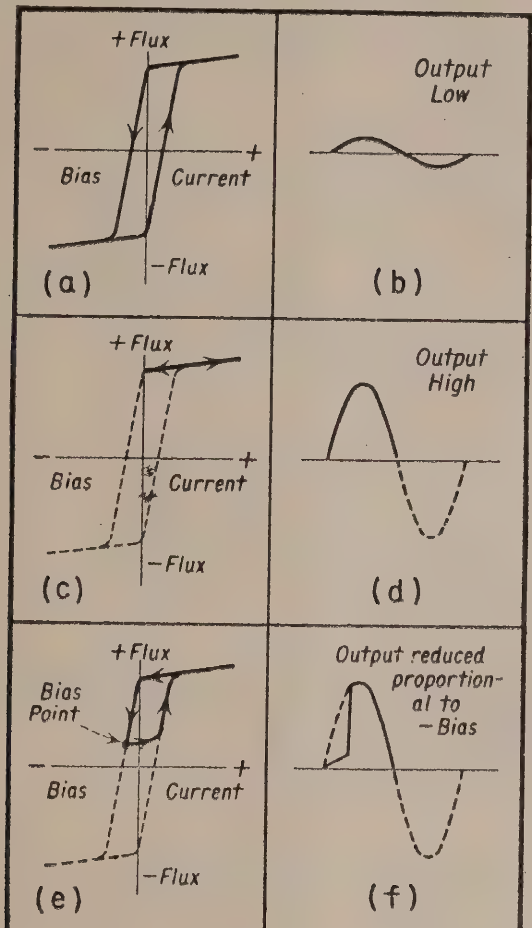
basic circuit of this type is shown in Fig. 3. Here a rectifier having a high front-to-back impedance ratio is inserted in series with the load circuit of a saturable reactor. The D.C. control circuit is isolated from the load A.C. by an inductance. Improved amplifiers of this type, when used in conjunction with the new square magnetization-loop core materials, are capable of power gains approaching *one million.*

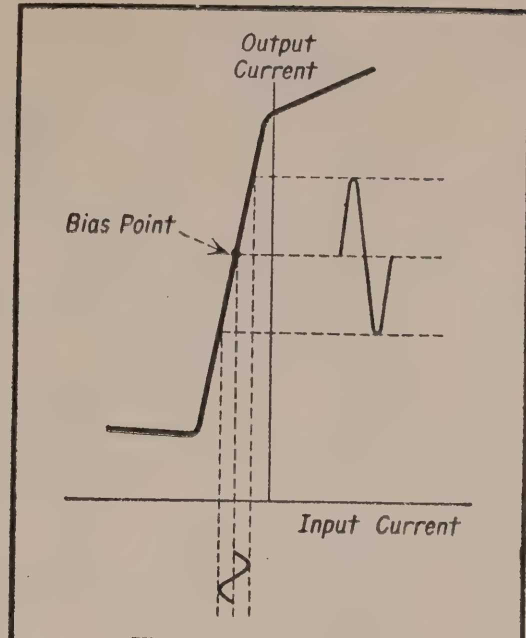


ACTION OF SELF-SATURATING AMPLIFIER

FIG. 4

To understand the operation of self-saturating magnetic amplifiers, let us examine the typical magnetization (or hysteresis) loop of Fig. 4a. This is the kind of steep-sided, easily saturated characteristic required of the saturable reactor in the circuit of Fig. 3. In the absence of control current and without the rectifier in series with the load, the operating point would trace out the entire magnetization loop each A.C. cycle. The resulting output wave would then be as in Fig. 4b. The insertion of the rectifier eliminates alternate half-cycles of the output wave as in Fig. 4d and produces a D.C. component in the load circuit which saturates the core in one direction during conducting half-cycles. The locus of the operating point is shown then along the saturated top of the loop, as indicated by the solid line in Fig. 4c. The core remains saturated since the rectifier prevents the flow of current in the negative direction required to produce demagnetization. The output voltage is maximum under this condition, since the continued saturation of the core results in low inductive reactance in the load coil and, hence, low voltage drop across it.

Now, suppose that a D.C. control current is introduced in the control winding in a direction which tends to produce saturation of the core in the direction opposite



TYPICAL TRANSFER CHARACTERISTIC

FIG. 5

to that produced by the rectified load current. Then, during the half-cycle when the load rectifier is not conducting, this control current reduces the magnetization of the core to some value on the negative-going part of the loop, as in Fig. 4e. If the value of this bias current is large enough, it may even saturate the core of the reactor in the reverse direction. When the rectifier again conducts, it overcomes the effect of the control current and again saturates the core as in 4c. To do so, it must re-establish the flux density which was reduced by the negative control current. Note that the amount of flux which the load current must set up before it again saturates the core is directly proportional to the control current if the hysteresis loop has essentially straight sides.

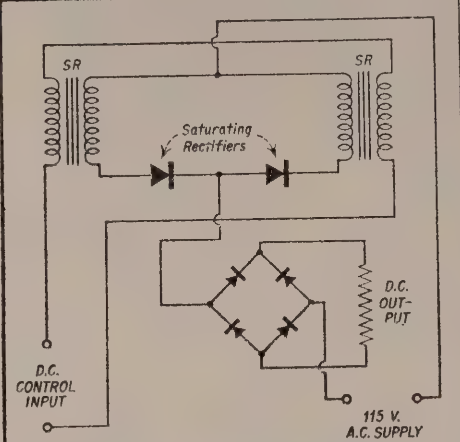
Since it takes a finite time for the load A.C. component to produce saturation of the core, depending upon how close to negative saturation the control current has driven the core, the output (voltage) voltage is reduced until positive saturation is reached. This results in the normal output waveform of Fig. 4d being modified as in Fig. 4f. The amount of load power reduction is directly proportional to the flux increment required to saturate the core from the bias point. The distortion of the voltage waveform results from the fact that the flux increment induces a back-voltage in the load coil which opposes the applied load voltage. In other words, the inductance of the load coil is high until the core reaches saturation. The control circuit thus controls the output power by controlling the flux increment required to reach saturation. The gain of the amplifier is large if the slope of the magnetization loop is large so that a small change in control current produces a large change in output current. A typical control characteristic would appear as in Fig. 5. Like the dielectric and vacuum tube amplifiers, the magnetic amplifier operating point may be set to any part of the control characteristic by the application of a fixed D.C. bias. When used as a D.C. amplifier, the device has the properties of the long sought "D.C. transformer."

ADVANCED AMPLIFIER TYPES

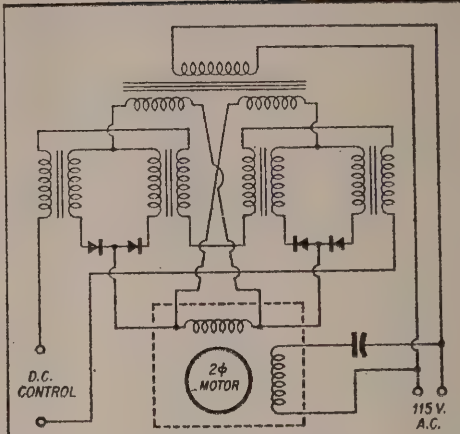
There are many variants of the basic self-saturating magnetic amplifier discussed above. Fig. 6 shows a full-

magnetic amplifier discussed above. Fig. 6 shows a full-wave circuit using two saturable reactors, two saturating rectifiers, and a bridge rectifier for D.C. output to the load. The saturating rectifiers are connected so that one load coil conducts on positive half-cycles and the other conducts on the negative half-cycles of the supply voltage. The control windings are in series. This connection gives the highest input impedance. Typical performance figures for an amplifier of this type are:

Input impedance	450 ohms
Load impedance	2000 ohms
Supply voltage	110 volts at 60 c.p.s.
Maximum power output	15 watts
Maximum power gain	200,000
Weight	3 lb.



PUSH-PULL MAGNETIC AMPLIFIER
FIG. 6



MAGNETIC AMPLIFIER FOR 2-PHASE MOTOR CONTROL
FIG. 7

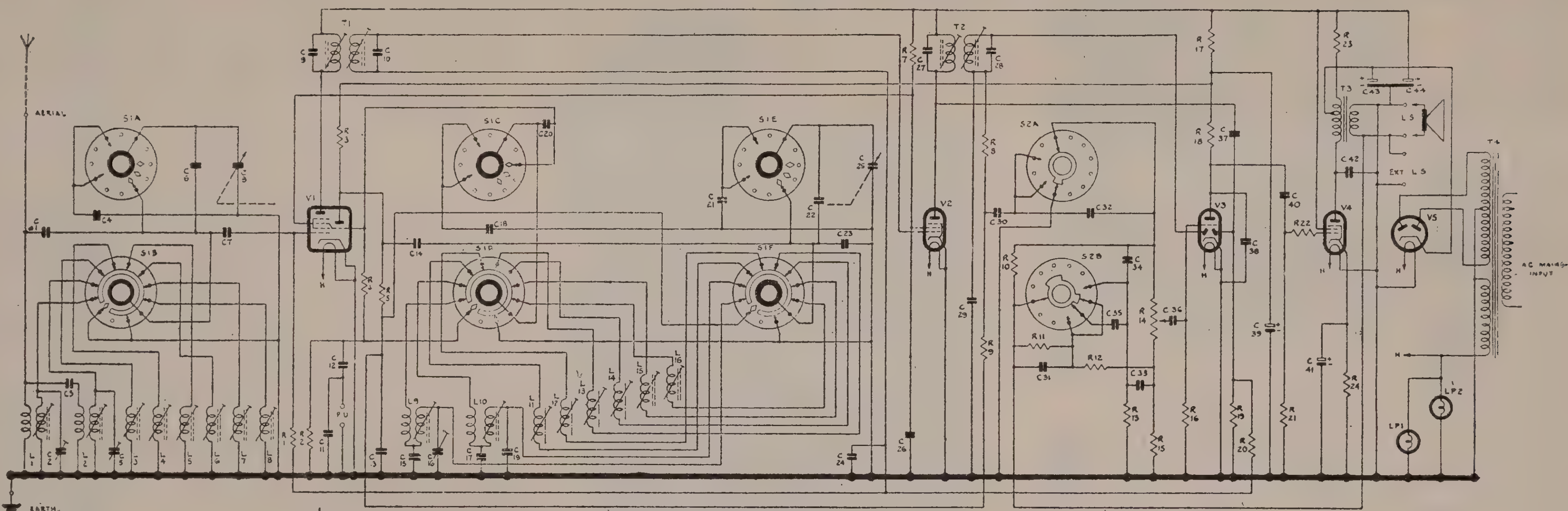
A further extension of the basic self-saturating circuit is shown in Fig. 7. This push-pull connection is arranged to control the speed of a 2-phase motor. Through the use of a high-gain amplifier of this kind, the power required to control a large motor is relatively small and can be derived from a small rheostat, an electronic tachometer, or some other sensing device.

COMPARISON WITH OTHER AMPLIFIERS

The magnetic amplifier is a comparatively low input impedance device whereas both the vacuum tube and dielectric amplifiers have high input impedances in most circuit connections. For this reason, the magnetic type is frequently combined with these other kinds in applications which require high input impedance.

FOR THE SERVICEMAN

circuit diagram of the PYE type PZ39 type PZ40



NOTE. ALL SWITCHES SHOWN IN FULLY ANTI-CLOCKWISE POSITION, I.E. WAVECHANGE SWITCH S1 IN 'GRAM' POSITION, AND TONE SWITCH S2 IN 'OFF' POSITION. ALL SWITCHES ARE VIEWED FROM THE FRONT, AND THE DIRECTION OF ROTATION IS CLOCKWISE.

CONDENSERS

	Specification	Volts	±	Fig.	No.
C1	5-6 pF Ceramic		20%	4	666659
C2	3-50 pF Trimmer			4	800076
C3	47 pF Ceramic		20%	4	666660
C4	150 pF Mica		2%	4	664130
C5	3-50 pF Trimmer			4	800076
C6	82 pF Mica		2%	4	664092
C7	100 pF Ceramic		20%	4	666520
C8	528 pF Swing Gang Condenser			1 & 3	800032
C9*	100 pF + 100 pF Mica		2%	1 & 3	
C10*					
C11	0·01 µF Tubular	150		4	669082
C12	0·01 µF Tubular	150		4	669082
C13	0·01 µF Tubular	350		4	669096
C14	560 pF Ceramic		20%	4	666678
C15	510 pF Mica		2%	4	664260
C16	3-50 pF Trimmer			4	800076
C17	2700 pF Mica		5%	4	664938
C18	150 pF Mica		2%	4	664130
C19	27 pF Mica		10%	4	666517
C20	100 pF Ceramic		20%	4	666520
C21	150 pF Mica		2%	4	664130
C22	150 pF Mica		2%	4	664130
C23	15 pF Ceramic N750K		10%	4	666515
C24	0·05 µF Tubular	350		4	668966
C25	528 pF Swing Gang Condenser			1 & 3	800032
C26	0·05 µF Tubular	350		4	668966
C27*	100 pF + 100 pF Mica		2%	1 & 3	
C28*					
C29	100 pF Ceramic		20%	4	666520
C30	0·02 µF Tubular	500		4	668594
C31	0·25 µF Tubular	350		4	668609
C32	0·005 µF Tubular	150		4	669081
C33	0·05 µF Tubular	350		4	668599

CONDENSERS, Contd.

	Specification	Volts	±	Fig.	No.
C34	82 pF Ceramic		20%	4	666677
C35	0·02 µF Tubular	500		4	668594
C36	0·05 µF Tubular	350		4	668966
C37	47 pF Ceramic		20%	4	666660
C38	100 pF Ceramic		20%	4	666520
C39	16 µF Electrolytic	350		1 & 3	667537
C40	0·005 µF Tubular	350		4	669095
C41	50 µF Electrolytic	12		4	667171
C42	0·005 µF Tubular	1000		1 & 3	668870
C43	32 µF + 32 µF Electrolytic	350		1 & 3	667504
C44					

INDUCTANCES

	Specification	Ref.	Fig.	No.
L1	M.W. Aerial Coil	M.W.7	4	780246
L2	M.S.W. Aerial Coil	M.S.W.4	4	780338
L3	31 m. Aerial Coil	S.W.6	4	780276
L4	25 m. Aerial Coil	S.W.5	4	780277
L5	19 m. Aerial Coil	S.W.4	4	780278
L6	16 m. Aerial Coil	S.W.3	4	780272
L7	13 m. Aerial Coil	S.W.2	4	780279
L8	11 m. Aerial Coil	S.W.1	4	780280
L9	M.W. Osc. Coil	M.W.9	4	780254
L10	M.S.W. Osc. Coil	S.W.12	4	780255
L11	31 m. Osc. Coil	S.W.7	4	780275
L12	25 m. Osc. Coil	S.W.6	4	780276
L13	19 m. Osc. Coil	S.W.5	4	780277
L14	16 m. Osc. Coil	S.W.4	4	780278
L15	13 m. Osc. Coil	S.W.2	4	780279
L16	11 m. Osc. Coil	S.W.1	4	780280

RESISTORS

	Ohms	Watts	±	Fig.	No.
R1	1 meg.	¼	20%	4	670410
R2	10 meg.	¼	20%	4	670416
R3	10,000	¼	20%	4	670398
R4	82,000	¼	20%	4	671047
R5	220,000	¼	20%	4	670406
R6	Not used				
R7	27,000	¼	20%	4	671218
R8	220,000	¼	20%	4	670406
R9	220,000	¼	20%	4	670406
R10	2·2 meg	¼	20%	4	670412
R11	4,700	¼	20%	4	670396
R12	2,200	¼	20%	4	670394
R13	390	¼	20%	4	671061
R14	1 meg. Volume Control			4	810241
R15	220	¼	20%	4	670388
R16	10 meg.	¼	20%	4	670416
R17	4,700	¼	20%	4	670396
R18	220,000	¼	20%	4	670406
R19	1 meg.	¼	20%	4	670410
R20	1 meg.	¼	20%	4	670410
R21	470,000	¼	20%	4	670408
R22	10,000	¼	20%	4	670398
R23	1,600 Wire Wound	4	5%	4	671836
R24	180	¼	10%	4	670509

TRANSFORMERS

	Specification	Fig.	No.
T1	1st I.F. Trans. Prim. 12·2 Ω; Sec. 12·2 Ω	1 & 3	770369
T2	2nd I.F. Trans. Prim. 12·2 Ω; Sec. 12·2 Ω	1 & 3	770369
T3	Output Trans. Prim. Start to Tap 15 Ω; Prim. Start to Finish 500 Ω	1 & 3	770066
T4	Mains Trans. Prim. 35 Ω on 225 to 250 v. Tap; Sec. 270 + 290 Ω	1, 3 & 4	770480

SWITCHES, LAMPS, ETC.

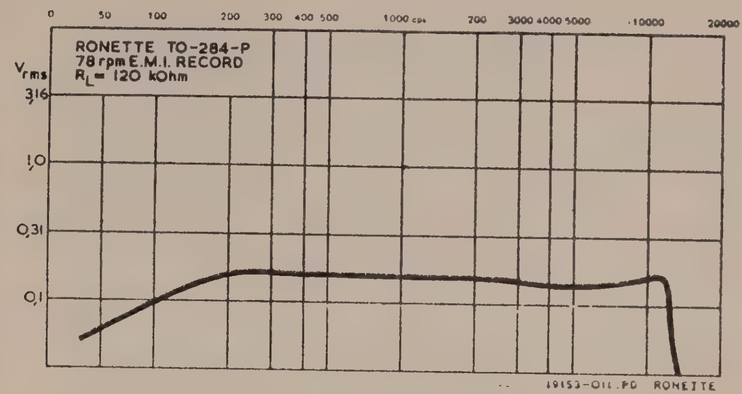
	Specification	Fig.	No.
S1A	Rear Bank 3 (Aerial Section) — Gram. and Wavechange Switch 9 position	4	830293
S1B	Front Bank 3 (Aerial Section)		
S1C	Rear Bank 2		
S1D	Front Bank 2 (Osc. Section)		
S1E	Rear Bank 1 (Osc. Section)		
S1F	Front Bank 1		
S2A	Rear Bank 1 — Tonemaster and ON/OFF Switch 5 position	4	830296
S2B	Front Bank 1		
S2C	Mains ON OFF Switch		
LP1	Dial Bulb 6·5 volt 0·3 amp.	1 & 3	700494
LP2	Dial Bulb 6·5 volt 0·3 amp.	1 & 3	700494
LS	Loudspeaker	1	850090

Note.—* Integral part of I.F. Transformer.

GALLAGHAN PRINT

The Editor's Opinion

A NEW CRYSTAL TURN-OVER CARTRIDGE



Voltage response curve of the 284-P cartridge on 78 r.p.m. test record, loaded with 120k. resistor.

It is interesting, to say the least, to find a crystal pick-up head for which the makers claim a performance equal to that of the best magnetic pick-ups, and even more interesting to find that this claim is substantiated by listening tests! Such, however, is the case with the new Ronette turn-over cartridge, recently received by the New Zealand distributors, Messrs. Green and Cooper Ltd., Wellington.

To be quite frank, the writer himself tended to be a little on the sceptical side, because the best magnetic heads these days have a remarkable performance, and it does seem almost incredible that a crystal should equal it. However, the maker's claims are not simply statements of his own opinion. He has intermodulation curves to prove his point, not to mention measured figures for other important characteristics of the new heads, in direct comparison with the best magnetic types, which everyone knows by name. Thus, when it comes to hearing the results produced by the Ronette 284 series in direct comparison with two very well-known and widely acclaimed high-fidelity magnetic types, we were in for a very pleasant surprise.

CONSTANT VELOCITY CHARACTERISTIC

Hitherto, one of the difficulties of applying crystal pick-ups has been that their response curves are exactly opposite in kind from that of magnetics. In other words, whereas the latter is a velocity-operated device, giving a flat response on a record cut with a constant-velocity characteristic, and a falling response (at the rate of 6 db./octave) on the frequency range that is cut at constant amplitude, the conventional crystal pick-up is an amplitude-operated device, giving a flat response on the constant-amplitude portion of a recording curve, and a dropping response (again at 6 db./octave) on the constant-velocity portion. This means in practice that the type of equalization curve needed for a crystal pick-up is exactly the opposite of that needed for a magnetic. It is therefore a difficult matter to compare the performance of the two types without arranging a special equalizer for one or the other. The Ronette 284 series, on the other hand, has the useful property of having a constant-velocity characteristic, just like a magnetic head, provided it is shunted by the correct value of resistor. The practical effect of this is that, provided a 120k. resistor is shunted across the terminals, **it can be used with a preamplifier or equalizer designed for magnetic pick-ups.** A simple and direct comparison then becomes possible. This is emphasized by the accompanying curve, which shows the frequency response of the type 284P, when shunted by 120k.

PHYSICAL ARRANGEMENT

The photograph, which is somewhat larger than natural size, shows the appearance of the 284 series of heads. They are not sold with arms, but have been arranged so that they can easily be fitted to almost any pick-up arm the purchaser might possess. The lever in front enables the head to be turned over, to bring the other stylus into action. The bracket has two mounting slots, half an inch apart, for mounting the cartridge to the arm. Connections are made by means of miniature sockets at the back end of the cartridge.

TRACKING AND INTERMODULATION

The manufacturer's data show that the pick-up handles, without excessive intermodulation distortion, recording amplitudes of up to six times that encountered on the average test record. Intermodulation in the best of the three types of head grouped under the number of 284 is below 1 per cent., according to the maker's measurements, and while it has not been possible to check the figures for the purpose of this report, listening tests certainly bear out the freedom from intermodulation. Reproduction is exceptionally clear, and it is easily possible to pick out individual instruments from a heavy piece of orchestral recording. It has also been proved to our satisfaction that the performance of the Ronette 284 series in this respect is even superior to certain high-fidelity magnetic types that are currently available. This was shown when the crystal played quite cleanly through several records which were thought to be over-recorded in certain spots, when played on other pick-ups!

Total harmonic distortion for an angular tracking error of ten degrees (a figure which need never be approached in practice) is quoted by the maker as just over 1 per cent., most of this being second harmonic. Another noteworthy feature is the large verti-

cal compliance of the stylus, which in common with other pick-ups using the same feature results in very small needle-chatter, the acoustic output being quite negligible. In addition, the output due to vertical movement of the stylus is stated to be 25.2 db. lower than the desired output, due to lateral movement in the 284P cartridge.

INDIVIDUAL TYPES AND THEIR CHARACTERISTICS

In the 284 series there are three types, called 284-O, 284-N, and 284-P respectively. Of the three types, the one with the best characteristic is the 284-P (P for professional), which also has the smallest output voltage. On a standard E.M.I. 78 r.p.m. test record, this head has an output which is flat within 2 db. from 50 to 12,000 c/sec., after which it is given a rapid roll-off. The droop to be seen in the response curve represents the actual low-frequency roll-off of the test record itself. The output, as can be seen from the curve, is approximately 0.1v., which is much higher than most magnetic heads of comparable performance. On the other hand, it is much lower than is obtainable from crystal pick-ups of mediocre performance. The main difference to be noted between the three types is that their output voltages increase as we go from type P to O to N. As is to be expected, this extra output voltage is had at the expense of slightly greater distortion. Even the N, however, which has an output of 0.3 volts under the test conditions quoted for the P type, gives only 1.25 per cent. intermodulation distortion at reasonable levels. It is noticeable, however, that the input velocity at which a rapid rise of intermodulation distortion occurs is lower for the O and N types than for the P.

Readers will want to know whether the differences between these three heads can be picked by listening tests, since, after all, that is the main question. The answer is that, given excellent amplifiers and speakers, the differences can be observed, but in our opinion they are sufficiently slight for the difference to be entirely negligible if ordinary radio sets and their speakers are used with the pick-ups. The price of these heads is remarkably low, which is another point in their favour, as is the fact that replacement styli are available and can be fitted by the user without any tools other than a small screwdriver, and without getting at the vulnerable inside works of the cartridge. Altogether, the series 284 Ronette heads are quite outstanding in the way of crystal pick-ups, and can hold their own with even the best magnetic heads. They should kill once and for all, the idea that there is no such thing as a high-fidelity crystal pick-up.

New Zealand Radio and Electrical Traders' Association

In presenting his Annual Report to the Annual General Meeting of the New Zealand Radio and Electrical Traders' Association held in Auckland recently, Mr. C. R. Peoples, President, commented upon the consolidation the Association had achieved during the past year, and forecast, as a result, better trading conditions for all. The incorporation of the Association, he felt, was a very wise and sound move. During the year, the Executive had made constant representations to the Board of Trade and various suppliers concerned, in an endeavour to ease the burden placed on retailers by the non-availability of certain classes of radio and electrical goods. He reported that the interests of individuals or firms handling electrical appliances are now guarded by the Association, which has already made representation to the Department of Industries and Commerce and the Board of Trade concerning some of the anomalies in this field. Steady progress has been maintained in the training of TV technicians at the Seddon Memorial Technical College, where the Association is endeavouring to establish an experimental television transmitter. Here finance constitutes one of the main problems. The establishment of a universal guarantee of 90 days on radio receivers has been prosecuted most vigorously by the Association, but unfortunately, it has proved impossible, as yet, to convince certain South Island traders on this point. Commenting upon the Fair Trading Policy, Mr. Peoples felt that there is yet much to be achieved on this score, but progress is difficult without unanimous agreement between wholesalers and manufacturers, particularly with regard to discounts offered by diary companies.

The election of officers for the year 1953-54 resulted as follows:—

President: Mr. C. R. Peoples.

Immediate Past President: Mr. S. Christie.

Vice-Presidents: Mr. H. J. Barr (wholesale section), Mr. J. Walch (retail section).

Executive: Messrs. M. C. L. Rhodes, D. Green, W. Hunter, W. J. Murphy, R. R. Stephen, E. Laircombe, B. Staff. Hamilton Area, J. K. Brackenridge (representing country groups).

Apprenticeship Committee: Messrs. S. Christie and W. J. Murphy.

Trade Certification Board: Mr. M. C. L. Rhodes, who was thanked for his services in the past.

ANNUAL SUBSCRIPTION

Fixed at same rate as last year.

MEMBERSHIP EXPANSION

It was unanimously resolved that the Executive investigate the possibiilty of expanding the membership of the Association by interesting in its affairs any firm substantially engaged in selling radios or electrical appliances.

RADIO GUARANTEES

The Executive undertook to prosecute the achievement of a universal 90-day guarantee period on new radios with the utmost vigour.

(Continued on page 48.)

TRADE WINDS

Practical TV Training in New Zealand

(Contributed by N.Z. Radio, Television, and Electrical Traders' Association.)

After two years' work by students and instructors, a pioneering adventure in technical training is being brought to a successful conclusion at the Seddon Memorial Technical College. Not only has the television serviceman's course proved interesting in its development, but it has been a means by which a Technical College, through its spirit of enterprise, is meeting the needs of industry even before these have actually arisen.

Thus, the College hopes to assist the radio trade by offering reliable technical information on servicing methods, and on the type of equipment required by television servicemen, with special regard to its cost and effectiveness. The latter is particularly important.

Constantly the instructors have borne in mind that they are training *servicemen,* not designers. Time given to training has been divided equally between theory and practice. Theory has been confined to the simplified non-mathematical treatment found in books such as Grob's *Basic Television,* or W. T. Cocking's *Television Receiving Equipment,* the former being exceptionally good, though, alas, somewhat expensive.

Practical work has covered the construction of many different types of sweep generators, including the Miller integrator. A circuit employing "flywheel" synchronization was built also, and found to produce excellent results. Generation of E.H.T. voltage by means of the R.F. oscillator, by voltage doubling and tripling using metal rectifiers, and by the flyback system, has been carried out successfully. Construction of a complete I.F. amplifier has also been carried out and the effectiveness of stagger tuning explored. In fact, at the moment, all students are engaged in tuning a three-stage I.F. amplifier with the use of a signal generator and V.T.V.M. This involves setting sound rejectors at correct frequency, as well as resonating the plate coils. Once each student has tuned his amplifier as a whole, he will then test the response curve with the use of a wobbulator.

The wobbulator in TV is an extremely useful piece of equipment, because it is one thing to tune the peaking coils of a stagger-tuned amplifier to their correct frequencies, but quite another to have the response curve of the amplifier of the correct shape and free from distortion. Unless the response curve is of the right shape, the result is displeasing to the eye. The wobbulator, which is not particularly expensive, is really indispensable for alignment of the video stage. Though many will work without it, undoubtedly such servicemen will be severely handicapped.

The practical course will conclude with the construction of twelve commercial Pye FV4 receivers imported in kitset form, thus providing Auckland's future TV servicemen with experience on a type of set likely to be encountered.

At present, 40 second year and 16 first year students are being trained. With one exception, all instructors belong to the trade, thus ensuring the maintenance of the proper practical aspect of training.

It is safe to say, therefore, that training television servicemen in our Technical Colleges is a practical proposition. At present, it is estimated that it requires about 300 man-hours to train a radio serviceman to become a good TV serviceman. Increased experience and the institution of continuous or full-time training, however, will effect a considerable reduction on this figure.

The sympathetic interest shown by the Principal of the Seddon Memorial Technical College has been a source of enduring strength and stimulation, and, through his good offices, the blessings of the Education Department have been bestowed on the scheme.

The College is also greatly indebted to its many good friends in the trade, who have helped with the provision of equipment and in countless other ways.

Standing solidly behind the scheme has been the New Zealand Radio, Television and Electrical Traders' Association of Auckland. Through its interest and activities, the College embarked upon its TV course, acquired its modern servicing laboratory, became the proud possessor of some very fine equipment, and hopes to obtain information on its TV Servicemen's Course from the North London Polytechnic, and to acquire another television receiver.

Perhaps one of the most pleasing features of the TV serviceman's course at the S.M.T.C. has been the support given by the Radio Workers' Union through its representative, Mr. Trevor Evans. Thus, employers and workers have co-operated for mutual benefit, and neither party has been slow to use the occasion to advantage.

Readers may be interested in a brief summary of the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factors leading up to the inauguration of this course.

Following the expressed desire of many radio-servicemen to extend their knowledge in the field of TV, the New Zealand Radio, Television, and Electrical Traders' Association not only appointed Mr. Waldo Hunter to act as Liaison Officer with Mr. R. B. Waddell of the Seddon Memorial Technical College in the matter, but actively supported the project by securing overseas contacts and information relative to TV training.

The College, having received a licence to transmit a television signal and a grant for £1200 from the New Zealand Government for the establishment of a laboratory and the procurement of equipment, arranged a course of study and training, and with the full co-operation of the Association in the procuring of additional equipment, hopes that its experimental transmitter will be on the air shortly.

Now, with the appointment of Mr. M. C. Rhodes as the employers' representative on the Trade Certification Board Advisory Committee, the Association hopes to secure a "Certificate of Qualification," which will be the recognized requirement of a TV serviceman under the Trades Certification Board.

* * *

E. R. COOPER MEMORIAL AWARD

In memory of the late Dr. E. R. Cooper, a fund is being raised to institute an annual award to scientific workers.

E. R. Cooper, M.Sc.(N.Z.), Ph.D., who died a year ago at the age of 42, was one of New Zealand's younger scientists who did much to advance the cause of science. His death was a serious loss to scientific research, organization, and administration. For a decade he guided development of the Dominion Physical Laboratory, which, beginning with a very small physics section, became under his directorship the largest branch of the Department. Besides his capacity as an organizer, he possessed outstanding scientific qualities. He always placed great importance on the publication of scientific work and the development of the natural resources of New Zealand. These two ideas have been incorporated in a memorial award sponsored by the Dominion Physical Laboratory Technical Advisory Committee of the Council of Scientific and Industrial Research, and the Department of Scientific and Industrial Research.

The award will be made annually to the author or authors of published physics or engineering papers who give the best account of their research work in New Zealand, preference being given to work that contributes to the development of the natural resources of this country.

The Royal Society of New Zealand has kindly consented to administer the award, and will appoint a selection committee consisting of representatives of the University (2), of the Royal Society of New Zealand (2), and of the Department of Scientific and Industrial Research (1).

EDUCATIONAL FILMSTRIPS

As part of its educational service, Mullard Ltd. has produced what are believed to be the first filmstrips covering a specific course of study. These form a series of 20 strips covering the two final years in the United Kingdom Ordinary National Certificate course in electrical engineering.

Though prepared primarily for the assistance of lecturers and teachers in technical training establishments, undoubtedly many of the strips will be found useful for senior science classes in grammar schools and for staff and apprenticeship training. The strips have been prepared with the assistance of an advisory panel composed largely of teachers in technical colleges.

In selecting the diagram, the tendency has been to concentrate on those normally involving laborious blackboard work and a greater degree of accuracy than can be obtained generally by freehand drawing. Teaching notes are provided with each strip, but no attempt has been made to produce a "potted" text-book.

* * *

POPULAR TELEVISION ASSOCIATION

Recently formed in London, with the Earl of Derby as its president, the Popular Television Association announces its purpose as "To awaken the national conscience to the dangers, social, political, and artistic, of monopoly in the rapidly expanding field of television, and to provide the public at the earliest possible moment with alternative programmes which are in keeping with the best standards of British taste, and to free from monopolistic control and to open up steadily widening opportunities of employment for artists, writers, producers, and technicians in all fields of the entertainment and electronics industries."

In a leaflet entitled "You and Commercial Television," it puts the case for competitive television as seen by the association, emphasizing that there would be no lowering of standards of taste, and that all programmes would be subject to a most rigorous code of ethics.

"As both commercial and B.B.C. programmes improve under the spirit of competition," it comments, "so, too, will television sales. This, of course, means greater employment throughout the industry."

* * *

COMMERCIAL TELEVISION IN BRITAIN

With speculation rife in New Zealand concerning the form of television to be adopted here, news of the British scheme for advertising broadcasts has been received with much interest.

Contending that there is a world of difference between accepting advertisements and sponsoring, Lord de la Warr has pointed out that the Press accepts advertisements, but remains responsible for its own news and editorial columns. Similarly, cinemas show advertisements in the interval, but their programmes are not sponsored by advertisers. "The Government has made it clear," he said, "that it envisages a system whereby the station and not the advertiser is responsible for the programmes. We realize the misgivings that have been expressed by thoughtful and serious people, and in the White Paper we shall show that we respect these feelings. We are confident that when the country sees our proposals it will feel we have provided the competition that is needed in a wise and statesmanlike manner."

Such a proposal provides much food for thought, and we hope that its progress will be watched with interest by all responsible authorities in New Zealand as well as by the general public, so that, should commercial television be our lot, we shall at least be able to avoid the programme pitfalls experienced in some of the larger countries today.

* * *

TELEVISION DOES NOT REPLACE SOUND BROADCASTING

That sound services will not be replaced by television is evident from the recently published report of the B.B.C. on its 10-year plan. According to the best advice available, the Corporation considers that within ten years' time, while there will be about 7,000,000 television sets in the hands of the public, there will be at least 6,000,000 households in the United Kingdom equipped with sound radio sets only. "The statistical position," states the report, "reinforces the evidence from other sources that sound radio will remain of great importance for as long as anyone can foresee. . . ."

"The technical developments," the report continues, "both for television and sound, will be accompanied by a progressive development of the standard of the programmes. It must not be thought that the spread of television will cause a stagnation of thought and action in sound, and there is ample provision in the plan for improvement commensurate with the continuing size and importance of the sound audience."

Aristocrats of Sound Reproduction!

Current model Rola loudspeakers are the descendants of an illustrious family whose performances in the field of reproduced sound have won wide acclaim.

More than 3,000,000 Rola loudspeakers have been fitted to Australian radio receivers because both manufacturer and user agree that only with a Rola loudspeaker is it possible to reproduce every delicate tonal shading and so recreate the beauty and majesty of the world's great music.

The New Zealand Electronics Insitute Inc.

At a N.Z.E.I. (Inc.) Council meeting held on 10th September last at Dunedin, the following new members were admitted:—

Associate Members: D. B. Billing (Wellington), J. M. Shanks (Palmerston North).

Graduate: J. D. Matheson (Dunedin).

Associate: J. R. Wilson (Wellington).

The Institute's prize for the student obtaining highest mark in the Radio Serviceman's Examinations was awarded to Mr. A. C. Aylett of Auckland, for the May, 1953, examinations. The conditions of the award of this prize will be reviewed at the next Council meeting.

Agreement was reached upon an interim allocation of funds to branches. The first payment will be made in October, and the position will be reviewed in February, 1954, when the final allocation will be decided.

As a step towards increasing the prestige of the Institute, the Council has decided to grant to members of the professional grades the privilege of using appropriate letters after their names. The approved abbreviations are: Member, M.N.Z.E.I.; Associate Member, A.M.N.Z.E.I.; Graduate, Grad.N.Z.E.I. These are the only abbreviations recognized by the Council, which will not countenance the fraudulent or incorrect use of these letters, nor the use of other letters purporting to refer to the New Zealand Electronics Institute (Inc.).

WELLINGTON BRANCH

Recent meetings of the Wellington Branch of the Institute, in August and September respectively, were devoted to lectures by Mr. Sample, of the Wellington Hospital's X-ray department, and Mr. D. Jenkins, Civil Aviation Branch of Air Department, whose subject was "Aircraft Communications." Mr. Sample's lecture covered the diagnostic and clinical use of X-rays, and was complementary to a recent visit made by the Wellington Branch to the Hospital, when the X-ray equipment was explained and demonstrated. While this lecture was concerned more with the medical uses of X-rays, rather than with the electrical methods used to obtain them, this was felt to be a type of talk which could usefully be heard more often, since those concerned with electronics tended to become too closely associated with the mechanics of their work, at the expense of a full realization of the uses to which it is often put.

Mr. Jenkins's talk likewise laid emphasis more on the operational uses of electronic communications than on methods actually employed. A full appreciation of the problems confronting the user of communications equipment is essential if designers are to exploit their electronic "box of tricks" to the fullest operational advantage, and Mr. Jenkins's lecture brought home in no uncertain manner the fact that equipment used for aircraft communications work is becoming more and more conditioned by the fact that communications are now faced with unprecedented

(Continued on page 48.)

Radio Round-Up

NEWS and VIEWS

Mr. E. W. Grant, chief engineer of Akrad Radio Corporation, the manufacturing subsidiary of Pye (New Zealand) Ltd., left by air for England on 6th October. He is to join the team of engineers coming to New Zealand in connection with the television broadcasting display to be staged by Pye at the Industrial Show in Wellington next January.

* * *

Home from their voyaging are two popular members of the Pye organization in New Zealand, Mr. George Wooller (managing director) and Mr. Don Cooper (director). They have been visiting Britain in connection with the forthcoming Pye television display at the Industrial Show in Wellington next January. From all accounts, the capital city will be treated to something rather special in the way of TV demonstrations. The equipment to be used comprises three complete camera chains, a transmitter, and approximately 70 receivers, all of which are scheduled to arrive here in time for test transmissions early in December. Nightly stage programmes will be televised, and can be viewed not only on receivers installed at numerous points inside the Show Building itself, but, should reception conditions be favourable, on others situated in the main Pye dealers' shops in the city. Since the transmitter to be used will not be a high-powered one, tests will be undertaken to ascertain whether the signal strength in Wellington will be great enough to over-ride the high noise level. We wish Pye every success in their venture.

Other interesting equipment to be shown by Pye (N.Z.) Ltd. at the forthcoming Industrial Show will include their miniature camera using a Staticon camera tube only six inches long. This will be demonstrated with its own synchronizing equipment, just as it is used for industrial purposes. One of the most interesting features of this equipment is the low-powered oscillator modulated by the camera signal. This can be tuned to any of the five standard B.B.C. channels. The output is then taken by coaxial cable to standard 405-line receivers, lessening the expense of the system to industrial users.

* * *

Overseas travel these days is certainly not devoid of incident, according to George Wooller and Don Cooper. During their fleeting visit to Singapore on their return journey, a party of terrorists murdered someone, and in turn had one of their own number shot dead within half a mile of the famous Raffles Hotel. While the forces of law and order are gradually gaining the upper hand, it seems that such incidents are by no means uncommon, but, according to Don, the population takes very little notice of them!

* * *

CANADA'S FOURTH TV STATION AT VANCOUVER

Marconi's Wireless Telegraph Co. Ltd., through Canadian Marconi Company, will supply the complete transmitter, studio, and mobile broadcasting equip-

ment for Canada's fourth television station to be situated in Vancouver. This is to have a 5-kilowatt vision transmitter and a 3-kilowatt sound transmitter, with combining unit and ancillary equipment. The outside broadcasting unit is to consist of a van fitted with two camera channels, monitoring and production gear, and a microwave link for sending the signals back to the station. The studio will have three camera channels, monitoring and production equipment, and a master control unit.

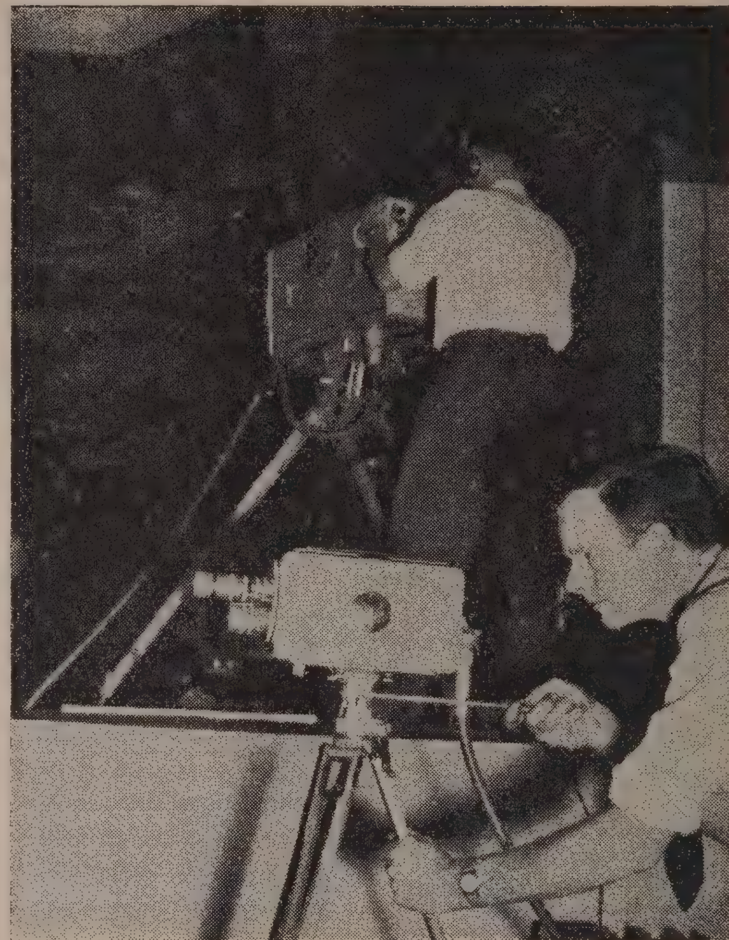
The system will operate on the North American standard of 525 lines, 60 cycles. Vancouver will broadcast its own programmes, and will not be linked with the existing Montreal-Toronto-Ottawa network in Eastern Canada, except by telecine recording.

* * *

Britain's National Radio Show

Broadcasting in all its aspects was the theme of the recently held National Radio Show, where Britain's leading radio and television manufacturers displayed their products to visitors from all over the world. The exhibits ranged from the largest television set to a microscope with a television-size screen, together with electronic and radio equipment for use of industry, commerce, and medicine.

The wider aspects of radio and electronics were demonstrated by exhibits which included the first public clock controlled by radio pulses from Rugby, accurate to thousandths of a second; an instrument on which the public could test the accuracy of their watches, electronic equipment for factory and office; and one of the Ministry of Supply's guided missiles with specially plastic encased components.



One of the outstanding features was a new television camera which has been designed for industry. The camera, weighing only 12½ lb., is intended for use in dangerous places where the larger camera is inaccessible. The camera has a 6 in. long tube, one inch in diameter, and can be set up on a site and remotely controlled from a main control unit. It is transportable in two small cases and has been developed by a Cambridge firm of television and radio engineers. The picture on page 44 shows the new miniature television camera, the "Staticon Industrial," seen against the large standard television camera in the background.

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"Break In," Vol. XXVI, No. 9, September, 1953.

"Radio-Electronics," Vol. XXIV, No. 8, August, 1953.

"Modern Manufacturing," September, 1953.

"Service," Vol. 22, No. 7, July, 1953.

"Radiotronics," Vol. 18, No. 9, September, 1953. (Amalgamated Wireless Valve Co. Pty. Ltd., Sydney, Australia.)

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"The Gramophone," Vol. XXXI, No. 361, July, 1953.

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"Wireless and Electrical Trader," Vol. 91, No. 1192, 15th August, 1953.

Cory-Wright & Salmon Ltd. Stock Record, August, 1953.

"Wireless Engineer," Vol. 30, No. 8, August, 1953.

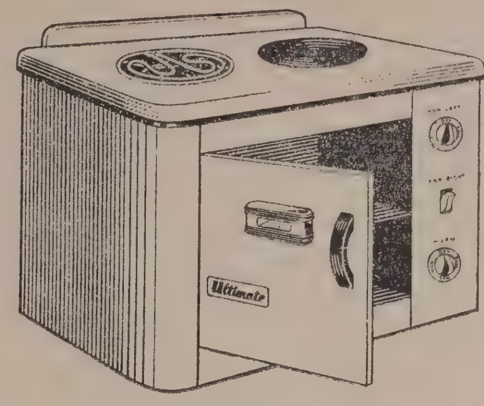
"Introduction to Valves," by R. W. Hallows and H. K. Milward (for review).

"A.P.A.E. Journal," Vol. 4, No. 8, August, 1953.

"New Zealand Electrical Journal," Vol. 26, No. 9, September, 1953.

NEW PRODUCTS

NEW "ULTIMATE" RANGETTE, MODEL EBL



The new Rangette illustrated here is, as far as we know, the only Rangette, or Table Cooker to be equipped with a modern radiant coil type element.

You will notice that the two elements on the top of the Rangette are controlled by switches on the switch panel on the right-hand end of the cooker and that the inconel or radiant element has the additional feature of having "Simmerstat" control.

The Rangette has an enamelled oven, is insulated on the outside with a heavy layer of glass-wool, and has a controllable top and bottom element to give perfect baking results. There is a heat indicator on the front of the door and the Rangette top is of heavy gauge steel, thickly vitreous enamelled. The body of the Rangette is in hi-bake enamel.

The Rangette takes the full 10 amps given by the ordinary 3-pin power socket in the home and is ideal for baches, flats, and small families.

Accessories include a scone tray and oven grill. A separate roasting dish can be supplied as an extra.

The Rangette remains at its previous price—£22 10s. retail.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d.

Electronics in Medicine

APPARATUS ON SHOW AT MANCHESTER

(Reprinted from "Wireless World," September, 1953.)

"If electronic engineers were acquainted with those problems confronting the medical profession which require their specialized knowledge, perhaps more of them would be attracted to the service of medicine." This observation was made about three years ago by a prominent member of Guy's Hospital Medical School. Since then, there have been signs that engineers are becoming more and more aware of the ways in which they can be of use to the medical world. The fact that their interest is growing is largely due to the efforts of the small band of technicians who spend their lives making specialized electro-medical apparatus in various hospitals around the country. Most of these technicians are men with a strong sense of vocation. They prefer working in the cause of medical science, for somewhat less pay than they could get in industry, simply because it gives them more personal satisfaction than making, say, guided missiles. Now they are beginning to organize themselves and make their presence felt in various ways.

A recent event which gave some prominence to their work was the Eighth Annual Exhibition of Electronic Devices, organized by the north-western branch of the Institution of Electronics at the Manchester College of Technology. The "Research" section of the exhibition was largely dominated by the stands of various hospitals and medical schools, and quite a number of firms were showing examples of commercial electro-medical apparatus. In addition, more than a third of the lectures given during the course of the exhibition were on electro-medical subjects. This being the dominant theme, it was appropriate that the proceedings should have been opened by Sir Geoffrey Jefferson, C.B.E., F.R.S., who is professor of neuro-surgery at Manchester University.

Although electronic techniques are used in both diagnostic and therapeutic work, there is perhaps more scope in the diagnostic field because of the wide range of different phenomena in the human body that can be detected or measured. The most common instruments here are probably the electro-cardiograph, for amplifying and recording heart potentials, the electro-encephalograph, for brain potentials, and the electro-myograph, for muscle potentials. After this, the apparatus becomes more specialized. The auscultoscope, for example, is an amplifying stethoscope for examining heart and lung sounds. The phonoelectrocardioscope amplifies heart sounds at the same time as recording the heart potentials, while the cardiotachometer measures the heart rate in beats per minute. Other instruments measure the rate of flow of blood and the amount of oxygen in it, and one called the sphygmograph registers pulse waves in the veins and arteries.

On the therapeutic side, the diathermy apparatus, or r.f. heater, is probably the best-known type of instrument. Nowadays it is quite often used by surgeons for making incisions and cauterizing wounds. Then there are stimulators. Most of these are devices for applying electrical waveforms directly to the body, but some generate flashes of light for visual stimulation and others sound pulses for aural stimulation. One stimulator made by Lorenz in Germany is used for giving artificial respiration by applying electrical impulses to the stomach muscles to produce a rhythmic contraction of the stomach wall. A new type of treatment which seems to be developing very rapidly is ultrasonic therapy, although most of the work seems to be confined to the Continent at the moment.

At one time radioactive substances were only used for therapeutic purposes, but they are now coming into the diagnostic field and bringing with them various electronic devices for detecting and measuring the radioactivity. In diagnosing cancer of the thyroid gland, for example, a dose of radioactive iodine is given to the patient; the iodine is selectively absorbed by the thyroid tissue and any cancer, and the resulting concentration of radioactivity gives an indication of whether a cancer is there or not and how big it is.

Ionization chambers and Geiger-Muller tubes are often used for detecting the radioactivity, but a much more sensitive instrument now coming into use is the scintillation counter. In this, the radioactive particles impinge on a phosphor and produce flashes of light, which are detected by a photo-multiplier tube. The output of pulses from the tube is then fed into an electronic counter, or rate-of-count meter, which indicates the strength of the radioactivity. One of these devices was shown at Manchester by Isotope Developments.

Unfortunately, the photo-multiplier tube introduces a certain amount of noise, which could lead to errors in the pulse counting. A way of overcoming this is to have two photo-multipliers "looking" at the phosphor and arrange their electronic circuitry so that only coincident pulses are counted. Any pulses coming separately from either tube are obviously noise, and are therefore not counted.

One scintillation counter working on this principle was shown at the exhibition by the University of Leeds. Another one was part of an extremely interesting apparatus, built by the University of London Institute of Cancer Research, which displays an image of the distribution of radioactive material in a patient's body on the screen of a cathode-ray tube. The patient is scanned mechanically by the scintillation counter, which moves backwards and forwards across him on a kind of large pantograph. Pulses from the counter are fed to an electrostatic storage tube (E.M.I. type VCRX350) and arranged to modulate its "writing" beam, which scans the target of the tube in synchronism with the mechanical scanning of the patient.

In this way a charge pattern is slowly built up on the target of the tube corresponding to the distribution of radioactive material in the patient's body. When a complete charge pattern has been formed, the "reading" beam scans the target at something like normal television speed, and the output signal is fed to the c.r.t. display to produce a corresponding visual pattern on the screen. The image formed in the storage tube can be "read" and displayed for about an hour before it fades away. One of the great advantages of the television type of display is that the contrast of the image can be altered electronically as required—a feature which was also to be seen in the flying-spot microscope shown by Cinema-Television.

A characteristic feature of the biological amplifiers used in medical work is that they usually have a differential input stage, consisting of a pair of valves with a common cathode load. The object of this circuit is to get rid of any interference picked up from the patient, which it does because the interference signal is usually in the same phase as both input grids and so cancels out at the anodes. To make the circuit give a high rejection ratio, however, the two valves have to be carefully matched so that they give exactly the same amplification, and this is not always easy to do. A new circuit, shown

by the University of Manchester, overcomes this difficulty by using only one triode valve, and connecting the two input leads, each through a cathode follower, to its grid and cathode. With this arrangement, the ratio of wanted signal-to-interference signal at the input is increased more than a thousand times at the output, and the interference signal can be hundreds of times greater than the wanted one before it has any appreciable effect.

Lewisham Hospital showed an apparatus for amplifying and recording the heart sounds of unborn babies—the purpose being to detect any changes in the heart rate indicating physical distress. The signals are displayed visually and a meter indicates their repetition rate.

A Government Policy Statement

(Continued from page 5.)

policy of the Government in approaching the problem of television in New Zealand.

"Will it be Government-owned or private ownership. Will it be commercial or national?"

Mr. C. A. Pearson, Television Executive of the Dominion Radio and Electrical Corporation, says:

"With the release of the proposed Television Standards, the first major step towards a national service has been made.

"The Government's present reluctance to commit itself further can be appreciated when the political, financial, and technical problems involved are fully understood. The fact that television facilities will have to be provided eventually is, however, freely acknowledged by the Minister in Charge of Broadcasting.

"It is none too early for those desirous of taking an active part in television to initiate the long-term planning so necessary for TV's efficient and effective development. This does not entail heavy financial expenditure, nor does it commit effort or money to uses which can become obsolete or redundant. The principles involved are applicable to manufacturer, wholesaler, retailer, and serviceman alike.

"Long-term television planning can be grouped into three main sections. Firstly, there is the need for overseas technical liaison and the local training of key personnel. Full encouragement should be given to staff and wholehearted support to technical training schemes.

"Secondly, adequate financial provision will be necessary to meet future television development and plant costs. Now is none too soon to create and progressively add to reserves which will eventually be used to meet substantial introductory capital charges.

"As television **supplements** sound radio and does not supplant it, the third essential is the long-term provision for suitable additional floor space necessary for TV manufacturing, selling, or servicing.

"Whilst Philco's immediate efforts are being concentrated on supplying the ever-increasing New Zealand demand for our radios and radiograms, preparations for television are well advanced. In this respect, we are indeed fortunate in being closely associated with an organization which in this year will produce and sell more than one million television receivers.

"With sound planning by the Government and all sections of the industry, television will pass through its logical development stages with dignity and honour, ultimately becoming an accepted service of major national importance and of great benefit to the entire community. When this is an accomplished fact, much satisfaction will be felt by those who are today pioneering this amazing new field of electronics."

N.Z.R.T.M.F. Annual Report

(Continued from page 21.)

Industrial Matters

With the divorce of the radio and television industry from the electrical industry, future industrial development in the former sphere lies in our own hands.

The past year has seen the establishment of the Radio Engineering and Servicing Apprenticeship Committee, and it is understood that the lists of skills required under the Act will shortly be legalized by the Trades Certification Board. This will facilitate the specialized training of future technicians and engineers, and encourage a better class of trainee to enter a fascinating technical field.

Where Are We Heading?

Concluding his report, Mr. Slade posed this important question, pointing out that the design and manufacture of radio sets, and future TV equipment were comparatively narrow channels of industrial endeavour. These should be used as stepping-stones to develop the immensely greater field of electronics as applied to industry and telecommunications.

Faster production with higher quality and more safety for machine operators could be achieved by the application of electronic devices in industry, and in like manner New Zealand's communication system could be improved and developed. The industrial consequences of research on nuclear physics alone opens up a vast new field of tremendous possibilities. "All we need," said Mr. Slade, "is a sufficient force of scientific personnel capable of developing the practical application of overseas research, and, in due course, of originating ideas themselves. We lack that support now, but it won't be for long. It only needs a little Government assistance to help us over the first hurdle, and from then on we will not only absorb the electrical and electronic engineer graduates of our universities, but, like other countries, will be crying out for more . . . The problems ahead and their scope, the cohesion amongst ourselves, the raising of our technical potential by the employment of scientific personnel, the sympathetic support of a Government fully aware of our strategic value, all add up to a bright picture for the future."

N.Z. Radio & Electrical Traders' Association

(Continued from page 35.)

FAIR TRADING

Some success has been achieved in this matter with regard to dairy company discounts. The recent attitude of the Education Department is viewed with considerable concern, and representations will be made to the Minister of Education.

COUNTRY GROUPS

The establishment of sub-groups of the Association in provincial areas is being considered, and it is proposed to hold a preliminary meeting in Hamilton in the very near future. It is hoped groups in other centres will be formed later, group contact with the Association being maintained through a group-nominated member, and each group having the right to send a delegate to Association Executive meetings.

TELEVISION

The Association is endeavouring to arouse interest in the establishment of TV transmission in Auckland, and the Executive hopes to place tangible propositions before members shortly.

BROADCASTING

Members were urged to offer suggestions for improved radio programmes, thus securing also increased radio sales.

New Use for Grid-Dip Oscillator

(Continued from page 15.)

once, this should not represent much difficulty. C_3 should be entirely inside the case, and inaccessible from outside.

For those who do not like the idea of this sort of power supply, the best plan would be to use a small one specially for the job. The one recommended elsewhere in this issue for use with the 455 kc/sec. alignment oscillator would suit admirably, without any modification whatever.

Philips Experimenter No. 73

(Continued from page 25.)

PY82:

(1) Power Rectifier.

Note.—The P-series valves all have 0.3 amp. heaters, and are intended for series operation in transformerless sets. Practically all of them, however, have E equivalents; thus, with 6.3 v. heaters, for parallel heater operation.

N.Z.E.I.

(Continued from page 42.)

demands for speed, in order that they may catch up with the ever-increasing speeds of aircraft themselves. In the past, the utilization of radio communication has not been nearly as effective as it might have been, since the relatively slow speed of aircraft movements has not necessitated the fastest possible methods of message handling and routing, but high-speed aircraft have revolutionized the ways in which radio is used by controlling authorities.

BRANCH TELEVISION PROJECT

Since many of the members who have been working on the TV project were attending the course of lectures in TV given in September by Mr. W. D. Foster, who is also chairman of the television committee, the regular weekly construction meetings were cancelled during September. They have now started again, however, and, with the addition of several new working members, considerable progress has been made.

The Magnetic Amplifier

(Continued from page 30.)

Like the dielectric amplifier, the output circuit of the magnetic amplifier must be supplied with alternating current since variable reactances are involved, while the vacuum tube plate circuit is usually supplied with D.C. For satisfactory reproduction of the output wave, the A.C. supply frequency should be at least five times higher than the highest frequency handled.